

Analysis of the Utilities' June 17, 2019, Natural Gas Leak and Emission Reports

SB 1371 (Leno) Natural Gas: Leakage Abatement
R.15-01-008/D.17-06-015/D.19-08-020

California Public Utilities Commission and California Air Resources Board Joint Staff Report

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Executive Summary

This is the fifth annual report compiled jointly by the California Public Utilities Commission (CPUC) and the California Air Resources Board (CARB) (2019 Joint Report) produced in compliance with SB 1371 (Leno – 2014) on natural gas emissions, as ordered by the CPUC Decision Approving Natural Gas Leak Abatement Program Consistent with Senate Bill 1371 (D.17-06-015).

The annual report analyzes and accounts for natural gas emissions from leaks and vented emissions in the natural gas transmission and distribution system in California.¹ This report estimates the annual methane emissions, the primary component of natural gas, from California's transmission, distribution and storage systems and discusses emissions by system categories, source categories and leak grades.²

California gas utilities and independent storage providers (ISPs), (respondents) filed their 2018 emissions data and information on or before June 17, 2019 pursuant to the data request issued by CPUC staff in March of each year. The annual data request includes reporting templates and associated guidelines to respondents.

Staff used the report filings and any other relevant information to prepare the 2019 Joint Report.³ Staff made minor adjustments to the categorization of 2015 and 2017 data in order to present comparable category level emissions estimates and trends.

The 2019 Joint Report omitted the chapter previously included for "Responses to Data Request Questions #1 and #7" as this material is included in the biennial Compliance Plans. However, Staff refer to the contributing factors of Best Practices, as relevant, throughout the document.

The information in this report should be used by stakeholders to help determine where potential emission reductions can be achieved to meet the State's overall goal of reducing natural gas emissions 40% by 2030,⁴ while maintaining the safe, reliable, and

¹ Unless specified as a fugitive leak or vented emission, for the purposes of this report "emissions" include both fugitive leaks, and vented emissions of natural gas.

² "System Category" refers to the grouping of assets by function within the natural gas delivery system. "Source Category" refers to grouping emissions based on like source, e.g. pipelines emissions, or M&R station emissions, which was performed in the previous Joint Report. See page 9 of this report for definition of leak grades.

³ R. 15-01-008, *Order Instituting Rulemaking to Adopt Rules and Procedures Governing Commission-Regulated Natural Gas Pipelines and Facilities to Reduce Natural Gas Leakage Consistent with Senate Bill 1371*

⁴ This goal was established by (SB 1383, Lara 2016).

affordable operation of the regulated gas storage and delivery systems as stated in SB 1371.

Key Findings:

The total estimate of emissions from leaks and vented emissions for the 2018 calendar year is 5,971 million standard cubic feet (MMscf) of natural gas, which is 428 MMscf or 6.7% lower than the emissions volume reported in 2017, and 631 MMscf or 9.6% below the 2015 baseline (See Table 1).⁵ The overall decrease from 2017 to 2018 is the result of significant emission decreases in Blowdowns, Graded Pipeline Leaks and pipeline damages, offset by minor increases in other categories. Only three of the seven system categories showed minor increases totaling less than 100 MMscf YOY (See Table 2: Total Emissions by System Category). A detailed analysis of emissions from individual categories is provided later in this report.

The total natural gas emissions of 5,971 MMscf equates to 2.67 million metric tonnes of carbon dioxide (MMTCO_{2e}) using the Intergovernmental Panel on Climate Change (IPCC) Forth Assessment Report (AR4) 100- year methane Global Warming Potential (GWP) of 25 or 7.70 MMTCO_{2e}, using the 20-year methane GWP of 72.

Table 1: Total SB 1371 Sector Emissions, 2015, 2017-2018

Sector Emissions	2015 Baseline	2017	2018	2015 Baseline to 2018 Change		2017 - 2018 YOY Change	
				MMscf, MMTCO _{2e}	%	MMscf, MMTCO _{2e}	%
Volume of Natural Gas (MMSCF)	6,601	6,398	5,971	(631)	(9.6%)	(428)	(6.7%)
Mass Equivalent, 100-Yr GWP, AR 4 (MMTCO _{2e})	2.96	2.86	2.67	(0.28)	(9.6%)	(0.19)	(6.7%)
Mass Equivalent, 20-Yr GWP, AR 4 (MMTCO _{2e})	8.51	8.25	7.70	(0.81)	(9.6%)	(0.55)	(6.7%)

This report further analyzes the total emissions by looking at individual categories and sub-categories that comprise the emissions for 2018. Table 2 shows emissions and trends by System Category, Table 3 shows total emissions and trends grouped by Source Classification, and Table 6, in the body of the report, shows emissions by reporting entity.

⁵ Methane is the primary component comprising approximately 93.4% of the volume of utility grade natural gas.

Table 2: Total Emissions by System Category, 2015, 2017-2018⁶

System Category	2015 Baseline		2017		2018		2015 Baseline to 2018 Change		2017 - 2018 YOY Change	
	MMscf	%	MMSCF	%	MMSCF	%	MMSCF	%	MMSCF	%
Transmission Pipeline	549	8%	505	8%	345	6%	(204)	(37%)	(160)	(32%)
Trasmission M&R Station	1,007	15%	1,014	16%	974	16%	(33)	(3%)	(40)	(4%)
Compressor Station	163	2%	152	2%	198	3%	35	21%	46	30%
Distribution Mains & Services	1,703	26%	1,394	22%	1,211	20%	(492)	(29%)	(183)	(13%)
Distribution M&R Stations	1,348	20%	1,334	21%	1,351	23%	3	0%	16	1%
Customer Meter	1,638	25%	1,683	26%	1,692	28%	54	3%	8	0%
Underground Storage	193	3%	233	4%	201	3%	8	4%	(32)	(14%)
Unusual Large Leak	-	0%	83	1%	-	0%	-	N/A	(83)	(100%)
Total	6,601	100%	6,398	100%	5,971	100%	(630)	(9.6%)	(428)	(6.7%)

The key drivers for the 9.6% decrease in emissions relative to the 2015 Baseline include decreased levels of Transmission Pipeline emissions (204 MMscf), and Distribution Mains and Services emissions (492 MMscf), which were partially offset by increased customer meter damage emissions (54 MMscf) and Compressor Stations (35 MMscf).⁷ Some of the differences between 2015 and 2018 reported emissions result from improved methods of estimating leaks and emissions, which do not represent actual reductions in emissions. Therefore, the relative change to the 2015 Baseline could change either up or down depending on any adjustments to the baseline emission estimates.

Transmission Pipelines accounted for 6% of the total 2018 emissions that reflect a YOY decrease of 160 MMscf (32%) from 2017. Within this system category the decrease was largely due to decreased Blowdowns of 158 MMscf (See Table 7 – in the body of the report).⁸ In addition, a larger net decrease from the 2015 Baseline of 204 MMscf (37%) was primarily due to decreased blowdown activities.

The Transmission Metering & Regulation (M&R) Station’s share of the total 2018 emissions remains unchanged from 2017’s total of 16%, but YOY emissions decreased 40 Mscf from 2017’s 1,014 MMscf to 974 MMscf in 2018. Most of the YOY change is due

⁶ For more sub-category details see Table 7: Detailed Emissions by Category, Source, and Classification 2015-2019. In addition, in 2015 and 2016 the Aliso Canyon storage well leak was excluded from Unusual Large Leaks because it was accounted for by other state agencies.

⁷ The apparent change in customer meter damages is due to better accounting for these damages and recategorizing above ground pipeline damages to meter set-assemblies and out of the distribution mains and services category.

⁸ A blowdown is the release of gas from a pipeline to the atmosphere in order to relieve pressure in the pipe so that maintenance, testing or other activities can take place (PHMSA). The decrease is attributed to the implementation of best practices utilizing cross compression, lowering line pressure, and bundling maintenance.

to decreased blowdown emissions. The net decrease from 2015 Baseline is 33 MMscf and attributed to decreased blowdown activity.

The Compressors Stations' share of the 2018 total emissions increased to 3% up from 2017's 2%. The 2018 Compressor Station emissions increased 46 MMscf (30%) due to increased operating hours and increased level of operating emissions (19 MMscf), blowdown activity (21 MMscf) and changes to survey practices (9 MMscf). In 2018 the CARB Oil and Gas Rule (COGR) took effect requiring quarterly surveys that helped update and account for components not previously listed, along with more stringent leak detection thresholds, as such, this has resulted in a slight increase in category emissions, and a significant increase in the number of leaks detected.⁹ Though, the number of leaks detected increased there was not a corresponding increase in emissions because they are repaired more quickly reducing leak duration. The COGR surveys provide new information on compressor facility leaks and improves our awareness of facilities emissions profiles.

The 2018 Distribution Mains & Services (DM&S) emissions decreased 183 MMscf (13%) YOY. A significant portion of the 88 MMscf decrease was due to PG&E's implementing their super emitter survey protocol that identifies and fixes large leaks throughout their service territory.¹⁰ In 2018, SoCalGas and SDG&E adopted an annual survey to specifically identify leaks from vintage materials (e.g. plastic installed before 1986), and positively reduced their projected Unsurveyed Leaks. Because their vintage plastic has a leak rate about ten times that of non-vintage plastic the annual surveys to find and fix these leaks reduces emissions. Also, pipeline damages decreased for two main reasons; 1) overall damage events decreased 60 MMscf attributed to greater outreach to call "811", and 2) a net 8 MMscf in above ground damages were recategorized to customer meters.¹¹

The Distribution Metering & Regulating (M&R) Stations emissions increased 16 MMscf (1%) YOY to 1,351 MMscf. However, this category of emissions increased in relation to total system emissions by 2% to 23% of 2018's total emissions. The slight YOY increase was due to utilities' re-categorizing assets and improving the accuracy of records within their asset management systems.

⁹ The CARB Oil and Gas Rule is promulgated under 17 CCR.

¹⁰ The super emitter protocol uses a complex set of algorithms that considers the super emitting leaks removed from the population and makes a proportional adjustment to the DM&S pipeline emissions.

¹¹ For any construction requiring trenching or digging all utilities ask everyone digging to use 811 to schedule the utility locate and mark service to ensure the construction activity does not "dig-in" to a gas line.

The emissions from Customer Meter Set Assemblies (MSAs) increased 8 MMscf (0.5%) YOY due to recategorizing above ground leaks associated with MSAs into this category from DM&S where they were reported in prior years. MSA emissions of 1,692 MMscf are virtually all population based and make up 28% of the 2018 total emissions.

The Underground Storage emissions decreased 32 MMscf (14%) YOY from 233 MMscf to 201 MMscf, primarily due to overall decreased compressor operating hours affecting both compressor and component emissions, better emissions and leak detection leading to timely repairs, and more accurate measurement. While the increased frequency of facility surveys required by the COGR detected a greater number of leaks, the emissions decreased due to quicker response to repairing leaks, and better emissions measurement. The new information gained from better and more frequent surveys of storage and compressor facilities informs our understanding of operating emissions profiles and indicates potential for instituting better practices and emissions estimation. In some cases, the greater awareness of emissions sources and how facilities emissions occur, especially for the ISPs, may provide a basis for updating their emissions estimates. This topic will be discussed at the 2020 Winter Workshop.

Lastly, in 2018 there were no unusual large leaks, as compared to 2017, which experienced 83 MMscf of unusually large leaks.

The significant changes in emissions grouped by source can be seen in Table 3: Total Emissions Grouped by Source Classification, and Table 7: Detailed Emissions (by Category, Source, and Classification) 2015, 2017-2018, in the body of the report.

Table 3: Total Emissions Grouped by Source Classification, 2015, 2017-2018

Source Classification	2015 Baseline		2017		2018		2015 Baseline to 2018 Change		2017 - 2018 YOY Change	
	MMSCF	%	MMSCF	%	MMSCF	%	MMSCF	%	MMSCF	%
Population Based Emissions	3,931	60%	3,926	61%	3,959	66%	29	1%	34	1%
Graded Pipeline Leaks	1,458	22%	1,207	19%	1,088	18%	(371)	(25%)	(119)	(10%)
Blowdown	603	9%	635	10%	425	7%	(179)	(30%)	(210)	(33%)
Vented	258	4%	242	4%	268	4%	10	4%	26	11%
Damages	318	5%	227	4%	154	3%	(164)	(51%)	(73)	(32%)
Other Leaks	33	0.5%	79	1%	76	1%	43	129%	(3)	(4%)
Unusual Large Leaks	-	-	83	1%	-	0%	-	N/A	(83)	N/A
Total Sector Emissions	6,601	100%	6,398	100%	5,971	100%	(631)	(9.6%)	(428)	(6.7%)

Consistent with prior years' the Population Based Emissions classification makes up the single largest source at 66% of the 2018 total emissions.¹² Population Based Emissions, which are calculated based on the number of units within an category multiplied by an emission factor (EF), show virtually no YOY change. See Table 4 below for a breakdown on the asset categories making up Population Based Emissions.

Table 3 shows that the largest changes in YOY emissions occurred in Graded Pipeline Leaks, Blowdowns, Vented Emissions, and Damages as follows:

- Pipeline Leaks decreased YOY by 119 MMscf (10%) due to a new super emitter program (PG&E), application of a modified three year average leak rate for calculating Unsurveyed leaks (SoCalGas and SDG&E), and the impact of annual vintage materials surveys on the Unsurveyed Leak calculation (SoCalGas and SDG&E).
- Blowdowns decreased significantly by 210 MMscf (33%) due to less cyclical maintenance activity levels, vacating the lines, and bundling practices.
- Vented emissions increased 26 MMscf (11%) due increased transmission compressor operating hours, increased levels from compressor operations, and transmission component emissions partially offset by decreased overall storage facility compressor operations and component emissions. Although implementing the COGR helped entities identify more components and emitting sources, it prompted better measurements and faster repairs with associated decreases in emissions.
- Damages emissions decreased 73 MMscf (32%) YOY due to decreased number of damage events across the board.

Table 4: Population Based Emissions Sources, 2015, 2017-2018

Population Based Emissions	2015 Baseline		2017		2018		2015 Baseline to 2018 Change		2017 - 2018 YOY Change	
	MMSCF	%	MMSCF	%	MMSCF	%	MMSCF	%	MMSCF	%
Transmission Pipelines, Pipeline Leaks	5	0%	7	0%	5	0%	0.1	2.0%	(2)	(29.5%)
Transmission M&R Stations, Station Leaks & Emissions	942	24%	929	24%	946	24%	4	0.4%	16	1.7%
Distribution M&R Stations, Station Leaks & Emissions	1,348	34%	1,334	34%	1,350	34%	2	0.2%	16	1.2%
Customer Meters, Meter Leaks	1,636	42%	1,655	42%	1,659	42%	23	1.4%	4	0.2%
Total Population Based Emissions	3,931	100%	3,926	100%	3,959	100%	28	0.7%	34	0.9%

¹² The Population Based Emissions is comprised of Transmission and Distribution M&R Stations (58%), Customer Meter Sub-Assemblies (42%), and Transmission Pipeline Leaks (>0.1%).

Conclusion:

The major findings from the 2018 data are:

1. The PG&E Super Emitter surveys had a positive impact decreasing PG&E Distribution Mains & Services (DM&S) pipeline emissions significantly by recognizing the impact of repairing and removing Super Emitting leaks from their distribution system.
2. The SoCalGas/SDG&E reduced emission in 2018 by implementing annual surveys focused on vintage pipe materials, which in the short term identifies more vintage leaks in the current period and removes them from the estimated unknown leaks (reported in Graded Pipeline Leaks). Over time the overall number of leaks in the vintage pipelines should decrease as they are detected and repaired on an annual basis. SoCalGas/SDG&E adopted a similar program for vintage steel pipe in 2019. PG&E adopted a similar program for vintage steel and vintage Aldyl-A pipes in 2018.
3. The implementation of maintenance best practices, which include vacating gas from lines, bundling work, and better scheduling techniques, continue to contribute to the significant reduction in blowdown emissions. Blowdown emissions fluctuate based on activity drivers (e.g. number of repairs, pipe replacement, dig-ins, general O&M, etc.) and emissions are expected to fluctuate depending on YOY activity levels.
4. The COGR resulted in more granular leak detection, shorter average time to repair that decreases emissions, focus on Compressor and Storage facilities' emissions, and switching from the use of annual facility or component EFs based on component population to emissions based on number of leaks using leaker EFs. The result was a net decrease in emissions from Component and Compressor leaks and facility leaks due to shorter time to repair and leak duration.
5. The more frequent COGR surveys helped identify increased emissions from rod packing indicating that when coupled with a proactive compressor emissions monitoring system for early detection of rod packing degradation and timely maintenance, these types of emissions could be decreased.

6. To the extent possible the cost of the additional COGR surveys and leak and emissions mitigation activities resulting directly from the additional surveys, should be considered for cost benefit analysis in future compliance plans. This would contribute to understanding of the holistic costs and benefits from all leak abatement activities.
7. Any adjustments to the 2015 Baseline that are needed to reflect more accurate reporting methods should be completed as soon as possible. An accurate 2015 baseline is important for all entities to have a firm idea what and where to reduce emissions. Also, now that D.19-08-020 will restrict cost recovery of PG&E's and SoCalGas's LUAF in 2025 should they fail to reduce emissions by 20% of 2015 Baseline. Staff will review the known issues with previously reported emissions balances and discuss the best approaches for adjusting prior period balances during the 2020 Winter Workshop, with the goal of making appropriate adjustments in time for inclusion in the 2020 annual report.
8. COGR changed emissions identification and accounting methodology, impacting 2018 emissions and has further implications on whether the respondents were fairly accounting for compressor and component emissions in prior years, including 2015. The information gained, from the enhanced survey protocols implemented in 2018, concerning compressors and storage facility emission profiles indicates that similar, emissions may have occurred during prior years. To fairly measure the success or failure of the emissions reduction program, the emissions baseline should be as accurate as possible. Therefore, an evaluation to determine whether baseline adjustments are appropriate appears warranted.

Introduction and Background

On September 14, 2014, Governor Jerry Brown signed into law SB 1371 that required reporting and verification of emissions of greenhouse gases (GHGs). The bill also requires gas corporations to file a report summarizing utility leak management practices, a list of new natural gas leaks by grade, a list of open leaks that are being monitored or are scheduled to be repaired, and a best estimate of gas loss due to leaks. In accordance with SB 1371, the California Public Utilities Commission (CPUC) and California Air Resources Board (ARB) prepared this annual report, which analyzes and accounts for natural gas from leaks and vented emissions from natural gas transmission, distribution and storage in California.¹³

SB 1371 also requires the adoption of rules and procedures to minimize natural gas leakage from Commission regulated natural gas pipeline facilities consistent with Pub. Util. Code § 961(d), § 192.703(c) of Subpart M of Title 49 of the Code of Federal Regulation, the Commission's General Order (GO) 112-F, and the state's goal of reducing GHG emissions.

In January 2015, the Commission opened an Order Instituting Rulemaking (R.) 15-01-008 (OIR) to implement the provisions of SB 1371.

On June 15, 2017, the Commission in D.17-06-015 (Gas Leak Decision) approved the Natural Gas Leak Abatement (NGLA) Program consistent with SB 1371. This decision established Best Practices (BPs) and reporting requirements for the NGLA Program to be developed by the CPUC in consultation with CARB.¹⁴ The decision implements the following to support the state's goal of reducing natural gas emissions by 40% by 2030:

1. Annual reporting for tracking natural gas emissions;
2. Twenty-six mandatory BPs for minimizing natural gas emissions pertaining to policies and procedures, recordkeeping, training, experienced trained personnel, leak detection, leak repair, and leak prevention;
3. Biennial Compliance Plan (CP) incorporated into the respondents' annual Gas Safety Plans, beginning in March 2018; and

¹³ Unless specified as a fugitive leak or vented emission, for the purposes of this report "emissions" include both fugitive leaks, and vented emissions of natural gas.

¹⁴ Leno, Chapter 525, Statutes of 2014; Pub. Util. Code §§ 975, 977, 978

4. Cost recovery process to facilitate Commission review and approval of incremental expenditures to implement BPs, Pilot Programs and Research & Development.

In the Gas Leak Decision, the Commission affirms that the 2015 baseline emissions estimates will provide the starting point to measure future natural gas emissions reductions.¹⁵ The rulemaking remains open to address implementation issues in a second phase.

To culminate the second phase of OIR.15-01-008; on August 15, 2019 the Commission approved Decision D.19-08-020 establishing additional policies and mechanisms for the NGLA program pursuant to Senate Bills (SB) 1371 and 1383.¹⁶

This decision requires:

- Utility Proposed Cost-Effectiveness Methodology and two Cost-Benefit Analyses for evaluating proposed methane reduction measures and the Biennial Methane Leaks Compliance Plans (Compliance Plans).
- Adopts a restriction on rate recovery beginning in 2025, for emissions greater than 20% below the 2015 baseline levels for Pacific Gas and Electric Company (PG&E) and Southern California Gas Company (SoCalGas) to ensure they achieve their intended emissions reductions.
- Two workshops to refine the scope and detail of the Compliance Plans and Tier 3 Advice Letters pertaining to cost-effectiveness and cost-benefit analysis and other elements as directed in Decision (D.) 17-06-015.
- Develop a process that utilities can rely on, prior to submittal of the next Compliance Plans in March 2020, to adjust Emission Factors (EFs) used for annual reports to account for methane reduction measures in consultation with CARB.
- Extending the timeframe from 2020 to 2021 for the CPUC's Safety and Enforcement Division and Energy Division Staff to complete a written program evaluation of the NGLA program after Commission approval of the second set of Compliance Plans in late 2020.
- Commission direction of the NGLA program moving forward, following submission of the second set of Best Practices Biennial Compliance Plans due March 2020 and the NGLA program evaluation in 2021.

All directives of D.17-06-015 remain in effect, unless they are superseded by directives and/or guidance provided by this decision.

¹⁵ <http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=190740714>, Finding of Fact #13, pg. 145.

¹⁶ docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M309/K591/309591641.PDF

In addition, SB 32, which sets a 40% GHG reduction target for 2030, was passed and signed into law in 2016.¹⁷ SB 605 (Lara, Chapter 523, Statutes of 2014) directed CARB to develop plans to reduce statewide natural gas emissions, which it did in the Short-Lived Climate Pollutants strategy.

Purpose of the Natural Gas Leak Abatement Report:

The report estimates emissions from the gas storage and delivery systems in aggregate, by entity, by system categories, by source classification and by grade. The information should be used to help determine where emission reductions can be achieved while maintaining the safe and reliable operation of commission-regulated gas pipelines and other facilities. The metrics used to compile this report provide operators, the Commission, and the public with information about the type, number, and severity of emissions and the leaked quantity of gas emitted to the atmosphere over time.

This report provides a summary of the 2018 emissions inventory reports submitted by the respondents on June 17, 2019, and differs from prior year reports due to the following:¹⁸

- The 2019 Joint Report includes year-over-year (YOY) comparisons to 2017 and the 2015 Baseline emissions.
- There were no emissions attributed to the Aliso Canyon natural gas storage facility leak for calendar year 2018, since the duration of the leak event spanned 2015 and 2016, those emissions were noted within the body of both the 2015 and 2016 Joint Reports.
- Continuing the practice from prior reports, Compressor Leaks and Component Leaks are combined across all years for both Compressor Stations and Underground Storage facilities. This was done to address comments from respondents that it is problematic to try to differentiate compressor leaks and components as in many cases they are integral systems.

In keeping with prior reports, in large part the data reported by gas companies in 2018 continued to require the use of 1996 GRI EFs consistent with prior years reports.¹⁹ The report includes general discussions of changes to operational practices, new

¹⁷ California Global Warming Solutions Act of 2006: emissions limit. SB32, Pavley, Reg. Sess. 2015-2016. (2016).

¹⁸ Respondents June 17, 2019 filings may be found on their respective websites.

¹⁹ See Appendix 9 of the Data Request for specific EFs recommended by each System Category.

<http://www.cpuc.ca.gov/General.aspx?id=8829>

methods for leak and emission detection and mitigation programs. Lastly, Staff tried to include improvements in the data capture (e.g. verification of asset inventory, integrating system databases, et al), changes to methodology for estimating emissions (e.g. calculating emissions for all blowdowns not just those above a specific threshold), and corrections to the classification of data or errors in the data that may provide greater accuracy in reporting.

Basis for the Annual Gas Leak Abatement Report:

On March 31, 2019, Staff issued a data request to CPUC jurisdictional utilities and independent storage providers (ISPs) in California to collect the information required by Article 3, Section 975 (c) and (e)(6), using templates jointly developed by CPUC and CARB. (See Appendix C for detailed wording.)

The data were tabulated into the following seven systems categories (which included subgroupings by type):

1. Transmission Pipelines (leaks, damages, blowdowns, components, and odorizers);
2. Transmission Metering and Regulation (M&R) stations (station leaks and emissions, and blowdowns);
3. Compressor stations (compressor leaks and emissions, blowdowns, components leak and emissions, and storage tanks);
4. Distribution Pipeline Mains and Services (leaks, damages, and blowdowns);
5. Distribution M&R stations (station leaks and emissions, and blowdowns);
6. Customer Meters (leaks, and venting); and
7. Underground Storage Facilities (leaks, compressors leaks and emissions, blowdowns, and component leaks and emissions. Dehydrators are omitted in 2016).

The respondents provided contextual information and explanations for their data to help CPUC and CARB Staff understand the composition of the emissions, emission sources and related calculations underlying the emission estimates. The respondents summarized the data and provided their system-wide leak information. Appendix A explains methods used to estimate emissions.

CPUC and CARB Staff jointly analyzed the data and requested supplementary information for clarification as necessary. The “Lessons Learned” section of this report

identifies insights Staff acquired about potential improvements to the process and opportunities to enhance future data requests.

Basis for Adjusting the 2015 Baseline Values:

On August 15, 2019 the Commission approved Decision D.19-08-020 establishing additional policies and mechanisms for the Natural Gas Leakage Abatement (NGLA) program pursuant to Senate Bills (SB) 1371 and 1383.²⁰

Since the beginning of the NGLA reporting process Staff and respondents have identified opportunities for improving reporting methodology, emission factors and record keeping. Had some of these improved emissions data been known or used at the time of the 2015 reporting year they would have had a material impact on the level of 2015 baseline emissions in the Joint Report. The June 2017 Commission decision (D.17-06-015) did not order a process for updating the 2015 Baseline, however, it ordered that:

“The Natural Gas Leak Abatement Program Annual Reporting Framework contained in Section 5.2 ... of this decision is adopted consistent with the process detailed below: The Commission’s Safety and Enforcement Division (SED), in consultation with the Air Resources Board (ARB), shall direct the annual report process...”²¹

This is interpreted to include the consideration and evaluation of any changes to 2015 Baseline emissions based on new methods of emissions accounting, better record keeping and information as well as updated factors used for estimating emissions.

Decision D.19-08-020 modifies the approach to updating EFs by allowing utilities to propose EF changes that more accurately account for the emissions from their Compliance Plan emissions mitigation programs. In addition, changes to 2015 Baseline EFs may be warranted based on the supporting data and evidence used to develop EFs for emission mitigation programs included in their Compliance Plans.

The discussion within D.17-06-015 further clarifies the roles and responsibilities for managing the emissions reporting processes.

“...[T]he development of EFs and an official baseline to manage this initiative in the long term is still in flux. Therefore, while, ARB is ultimately responsible for the development of EFs in collaboration with stakeholders, both ARB and CPUC should continue to collaborate to ensure that updates to EFs are completed in a

²⁰ docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M309/K591/309591641.PDF

²¹ D.17-06-015: Pg. 157

timely fashion consistent with the Commission's annual reporting process. Following this year's example, if changes are required to the annual reporting template, ARB and CPUC staff will conduct a workshop to discuss EFs and ongoing changes to the reporting template. This workshop should take place during the first quarter of each year before SED issues the annual data request at the end of the first quarter."²²

Therefore, in the 2020 Winter workshop Staff will discuss the impact of ongoing methodology and accounting changes and evaluate their impact on the 2015 baseline balances. At this time Staff are contemplating making 2015 Baseline adjustments in the NGLA 2020 Joint Report, and this will be one of the topics in the 2020 Winter workshop.

Some of the items identified for correction in the 2015 thru 2017 emission data based on new information received since initial reporting include:

- Revisions to the Southern California Gas (SoCalGas) and San Diego Gas & Electric (SDG&E) un-surveyed leaks in their Appendix 4 Distribution Mains and Services due to changes in methodology categorizing O&M leaks.
- Updating the 1996 USEPA/Gas Research Institute (GRI) emission factors (EFs) for customer meter set assemblies, and pipelines.²³ The new MSA EFs pursuant to the CARB EF study conducted in 2017 and 2018, a period where conditions and assets were relatively unchanged from 2015. Therefore, to the extent that the underlying EF study results correlate to 2015 emissions levels, the new information should be evaluated to determine whether it warrants updating the 2015 Baseline. Based on preliminary information there is a significant difference in the EFs 1996 GRI EF used and the 2018 GTI EF. The CARB report on the study is expected to be released in the fourth quarter of 2019. The MSA EF will be discussed in the 2020 winter workshop.
- COGR survey results indicate operating emission profiles at some compressor and storage facilities that are significantly different than reported using prior methodology. The COGR information is largely based on direct measurement, which, unless there are identifiable changes in facility assets, operations, or practices, could closely match the emissions profiles in prior years.

²² Ibid, Pg. 39

²³ CARB completed two EF studies based on California specific leak profiles; one for Distribution Mains and Services EFs and the second for customer MSAs. In addition, Washington State University (WSU) conducted a study of M&R stations emissions factors which indicate the current emissions factors are overstated by about 25%.

- In one case the method used to estimate blowdowns evolved since 2015, which indicates a change to the 2015 Baseline reported value that should be evaluated to determine whether a change is warranted.

There are various smaller adjustments related to methodology improvements, measurement protocols, and asset identification and re-categorization that may warrant retroactive application to the 2015 Baseline balances.

Findings and Discussion

Leaks and Emissions:

Based on the respondents' data, 2018 emissions totaled approximately 5,971 MMscf, which equates to 2.67 MMTCO_{2e} using the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) 100- year methane Global Warming Potential (GWP) of 25, or 7.70 MMTCO_{2e} using the 20-year methane GWP of 72 (see Table 1). This is a 6.7% YOY decrease from 2017 estimated emissions of 6,398 MMscf or 2.86 MMTCO_{2e}.²⁴ Also, the 2018 emissions are 9.6% lower than the 2015 Baseline of 2.96 MMTCO_{2e}.

System-wide Leak Rate

The System-wide Leak Rate is an important metric that shows the relative emissions to throughput from all respondents. SB 1371 requires annual monitoring of a System-wide Leak Rate for the transmission and distribution system.^{25 26}

The 2015 System-wide Leak Rate was 0.32%, slightly less than the 2018 system wide leak rate of 0.34% that reflects the decreased throughput in 2018 rather than any increase in emissions. The 2018 throughput volume was the lowest across the four years being tracked at 1,778,406 MMscf. The 2018 total emission volume was the lowest of the four years at 5,971 MMscf as well. The overall ratio has remained around a third of a percent across the four years.

²⁵ For the purposes of SB 1371, the definitions of "leak" and "gas -loss" and the formula for calculating a "system-wide gas leak rate" were defined in a different manner than elsewhere. For the purposes of calculating the System-Wide Leak Rate, a "leak" was defined as any breach, whether intentional or unintentional, whether hazardous or non-hazardous, of the pressure boundary of the gas system that allows natural gas to leak into the atmosphere. Any vented or fugitive emission to the atmosphere is considered a "leak". See Appendix B.

²⁶ Refer to Appendix C for PUC Code Section 975(e)(6), Article 3

Table 5: System-wide Emissions – Throughput Categories, 2015 thru 2018

Throughput Category	Natural Gas Volume (MMSCF)			
	2015 Baseline	2016	2017	2018
Total Storage Annual Volume of Injections to Storage	199,522	116,579	155,272	137,122
Total Storage Annual Volume of Gas Used by the Gas Department	NA	NA	1,933	1,782
Total Transmission Annual Volume of Gas Used by the Gas Department	7,717	6,107	5,875	6,185
Total Transmission Volume of Annual Gas transported to or for Customers in state	1,832,676	1,736,336	1,842,669	1,621,332
Total Transmission Volume of Annual Gas transported to or for Customers out of state	16,775	18,002	11,241	11,665
Total Distribution Annual Volume of Gas Used by the Gas Department	261	156	315	320
Total Throughput	2,056,950	1,877,179	2,017,306	1,778,406
Total Emissions	6,601	6,267	6,398	5,971
System-wide Leak Rate (Emissions/Throughput)	0.32%	0.33%	0.32%	0.34%

The total throughput showed a decrease in 2018 compared to 2017 with less gas injected into storage and less gas transported to customers in the State.²⁷ This activity correlates with the decrease in storage facility emissions, which correspond to fewer compressor hours for storage injections and withdrawals.

2018 Adjustments and Corrections

This report reflects a few minor adjustments to the data reported in the 2018 Joint Report.

- The 2018 Joint Report included reporting for MSA “All Damages” used to bifurcate above ground leaks associated with MSAs from DM&S damages.
- The EF for compressor and component leaks in Appendix 7 for Underground Storage was modified from thousand standard cubic feet per year (Mscf/year) to thousand cubic feet per day (Mscf/day).
- Small edits were made to replace “AND” with “or” in the “Vapor Recovery Units And Thermal Oxidizer” column
- Data from 2016 is only shown in the System-Wide Leak Rates - Table 5.
- Staff corrected a 50 Mscf data entry error in the 2017 report to correctly show West Coast Gas’s 2017 emissions at 422 Mscf.
- Staff adjusted the 2017 Transmission Compressor - Blowdown emissions that included 4,228 Mscf that GRGS mistakenly included in that category. They were moved to properly match up with the GRGS’s 2018 Underground Storage - Blowdown emissions.

²⁷ This category refers to natural gas that may be used by the utility itself, such as providing fuel to start-up a compressor or run an HVAC system for an occupied building at the storage site.

Data Management and Reporting

The top three utilities all describe continuing improvement and completing updates of programming software in 2018 to better record and analyze the data in their system. The quarterly surveys mandated by the COGR culminated in more details about the number of leaks down to 10,000 parts per million (ppm). The impact on emissions results are not fully apparent and therefore it is unclear whether results from these surveys are ultimately more accurate than the prior method of estimation based on population based EFs.

2018 Impacts of CARB's Oil and Gas Rule (COGR)

CPUC and CARB Staff compared leak data reported under SB 1371 with leak data pursuant to COGR. Staff observe that the reported data is similar but not necessarily the same in all respects. Even though there are similarities in the data not as much overlap occurs between the reports as was previously thought because of the different objectives of each report.

Both SB 1371 and COGR require descriptive entries, such as compressor facility name, type of compressor and facility address. For example, SB 1371 collects data to determine total annual emissions, whereas the COGR collects and evaluates quarterly reports of compressor component leaks to determine whether the reported leaks exceed the volumetric thresholds. COGR also requires annual emissions flow rate measurements from reciprocating compressor rod packing and centrifugal compressor wet seals to verify emissions are below allowed leak rates.

An additional observation is that both reports rely on the same surveys conducted by the gas companies, as evidenced by the matching date of inspection of leaks and date of repair of leaks.

Staff noted the following impacts on the SB 1371 Annual Report:

1. The quarterly surveys result in a greater overall count of component leaks. Staff observe that the overall increase in the number of discrete leaks is largely due to the more stringent leak survey protocols and lower leak detection thresholds. An increase in number of leaks, would normally result in an increase in emissions without some other offsetting or compensating effect.
2. The COGR imposed new leak repair requirements effectively reducing the average number of days to repair. Even though the number of leaks detected increased, the associated emissions decreased due to two factors: 1) leaks get repaired faster; and 2) the leak duration was based on the assumption that the

leak started after the last survey date or January 1st, which ever was more recent, and emitted through the day of repair.

3. Component leaks and emissions in Compressor Stations and Storage are now based primarily on Leaker EFs rather than Population EFs.
 - a. Some respondents informally raised concerns over whether using static Leaker EFs versus Population EFs is ultimately more accurate. Each provides an estimate of emissions and include potential issues. Population EFs could have issues due to an inadequate sample size that does not represent the population being measured. Leaker EFs could be problematic when volumetric precision is difficult to capture or when based on flow rates that may not properly consider key factors, such as gas pressure, temperature, and orifice size. Given that emissions profiles will not change when based solely on population-based metrics, any change to actual measurement and activity levels are seen in a positive light. When contemplating which EF or method to use the specifics and situational factors must be considered to ensure reasonable accuracy and applicability for measuring emissions.
 - b. Staff noted that after instituting COGR the compressor and storage emissions reported by the various respondents are inconsistent with some increasing and others decreasing. The more frequent surveys and direct measurements provide more situational information to help understand the factors driving these disparate changes.
 - i. The more frequent surveys helped identify increased emissions from compressor's rod packing prompting rod packing replacement. One respondent reported that it replaced its rod packing and experienced a net emission decrease, whereas another gas company reported higher overall emissions because it recorded a marked increase in emissions on one of its compressors due to worn rod packing. The higher meter reading times the hours of operation negatively impacted its emissions. This points to the benefits of instituting a proactive compressor emissions monitoring system for early detection of rod packing degradation.
 1. For example, Wild Goose Gas Storage (WGGS) created "(a) gas leak/repair tracking system ... to confirm that the required work was being performed, and the local air district updated with progress on leak survey results. The WGGS Operations group purchased a gas detection monitor, measuring concentration of

- the leak, which was used to confirm that repairs were successfully made.”²⁸
- ii. The component leak detection surveys were successful in identifying more granular leaks, and repair protocols instituted helped reduce emissions from leaks.²⁹ As expected compressor activity levels appear to be a significant factor in leak generation and emissions levels.
 1. Respondents observed that the surveys resulted in quick identification and repair of more leaks and thus reduction of methane emissions. “The implementation of quarterly leak surveys, ... versus annual leak survey, helped to ensure that leaks were identified earlier, and repaired within a 5-14-day window.”³⁰
 - c. To the extent possible the cost of the additional COGR surveys and leak and emissions mitigation activities resulting directly from the additional surveys, should be considered for drafting a cost benefit analysis in future compliance plans. The comparison would be to 2015 – 2017 emissions and the respective program and O&M costs to form a basis of comparison.

In 2018 we continued to observe improved reporting of event and activity details due to upgraded data management systems and operator best practices implemented to respond to SB1371 and COGR reporting requirements enabling them to disaggregate data and include additional components and assets not previously reported improving the quality of information.³¹

Summary of Gas Company Emissions

In 2018, the overall emissions decreased 6.7% from 2017 and decreased 9.6% below the 2015 Baseline. Table 6 shows each respondent’s 2015 Baseline compared to 2018, and the 2017 to 2018 YOY comparison. Importantly, Figure 1: 2018 Emissions Reported by Entity also highlights that the top four utilities make up approximately

²⁸ Ibid.

²⁹ Transmission Compressor Station leaks increased slightly due to an overall increase in operating hours which increase the opportunity for leaks, and challenge O&M scheduling to minimize disruptions to operations. The converse was seen in Storage facilities where overall decreased compressor operations had a corresponding decrease in both emissions and leaks.

³⁰ Wild Goose Gas Storage annual SB 1371 filing dated June 17, 2019.

³¹ “The level of details about pipeline components currently being requested have not historically been required by regulation to be tracked and therefore this level of detail cannot be readily queried from enterprise systems, which has limited reporting capabilities... The fact that the system was designed historically using equipment that was designed to vent natural gas as a normal mode of operation is not considered to be an unacceptable practice.” – Sempra Comments on the Revised Draft Report.

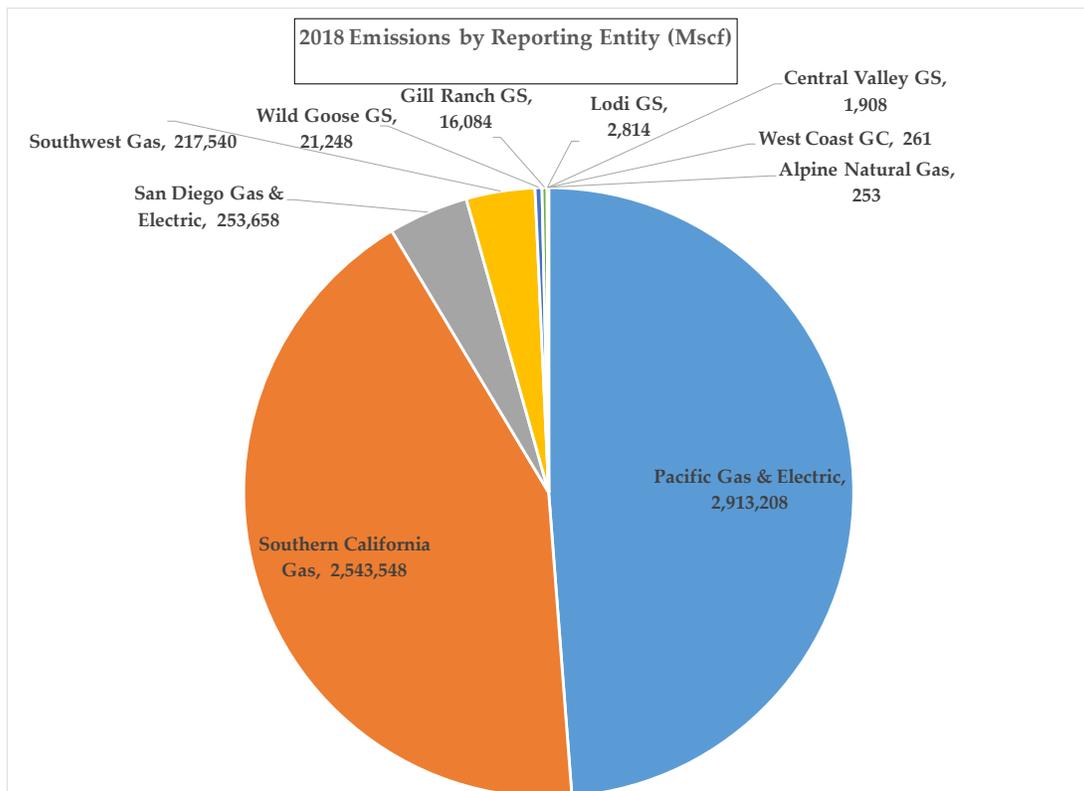
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99.3% of the emissions inventory while the remaining six utilities and ISPs make up the remaining 0.7% of the total system emissions.

Table 6: Emissions by Respondent, 2015, 2017-2018³²

Entity	2015 Baseline		2017		2018		2015 Baseline to 2018 Change		2017-2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Pacific Gas & Electric	3,294,368	50%	3,202,937	50%	2,913,208	49%	(381,161)	(12%)	(289,730)	(9%)
Southern California Gas	2,779,853	42%	2,696,512	42%	2,543,548	43%	(236,305)	(9%)	(152,963)	(6%)
San Diego Gas & Electric	282,041	4%	256,794	4%	253,658	4%	(28,384)	(10%)	(3,136)	(1%)
Southwest Gas	214,309	3%	212,575	3%	217,540	4%	3,231	2%	4,964	2%
Wild Goose GS	24,003	0.36%	17,755	0.28%	21,248	0.36%	(2,755)	(11%)	3,493	20%
Gill Ranch GS	3,636	0.06%	5,095	0.08%	16,084	0.27%	12,447	342%	10,989	216%
Lodi GS	1,638	0.02%	5,697	0.09%	2,814	0.05%	1,176	72%	(2,883)	(51%)
Central Valley GS	806	0.01%	469	0.01%	1,908	0.03%	1,102	137%	1,438	307%
West Coast GC	509	0.01%	422	0.01%	261	0.00%	(248)	(49%)	(161)	(38%)
Alpine Natural Gas	6	0.00%	244	0.00%	253	0.00%	247	4,410%	9	4%
Total	6,601,169	100%	6,398,499	100%	5,970,520	100%	(630,649)	(9.6%)	(427,980)	(6.7%)

Figure 1: 2018 Emissions by Respondent (Mscf)



³² The 2017 Joint Report had minor typographical errors which were corrected in this report. Therefore, the total reported for 2017 will differ by 50 Mscf.

Pacific Gas & Electric

PG&E's is the state's largest gas utility and has the highest level of emissions covered under SB1371 with 2018 reported emissions of 2,913,208 Mscf that decreased by 289,730 Mscf (9%), primarily driven by the decreased blowdowns and DM&S pipeline emissions.

The company underwent a combination of advancements in abatement efforts, changes in annual activity, and improvements to reporting practices, which contributed significantly to the overall decrease in emissions for 2018. Many of the lower emissions are due to reductions in blowdown emissions, reductions from damage emissions, faster repair timelines, additional leak surveys as well as reductions from component leaks at storage facilities. In addition, PG&E expanded data collection efforts and refined existing data sets, which resulted in improvements in emission accounting and provided reductions in several categories as noted below:

- Developed a Super-Emitter program in accordance with BP-21. The Super-Emitter program aims to rapidly detect and repair leaks larger than 10 standard cubic feet per hour (scfh). It uses a mobile leak detection system from Picarro and an algorithm that estimates the flowrate of the identified leaks.
- Employed a greater numbers of leak survey personnel and continued to invest in the vehicle-based leak detection system, Picarro.
- Continued with survey cycle modification for underground pipelines. Whereas previously PG&E surveyed some pipe materials on a 5-year and a 4-year-cycle, while in 2018 all pipelines were surveyed either on an annual, or a 3-year-cycle. This is in line with the best practices and its Compliance Plan reporting.
- Conducted a special leak survey on selected vintages of distribution pipes, consistent with Best Practice 16. The material focus of the special leak survey was to identify pre-1940 steel and pre-1975 Aldyl-A vintage pipes, both which are known to have higher leak rates. The special leak survey focused on pipe segments comprised of the vintage pipe materials that resulted in the identification and repair of additional leaks and an overall reduction in methane emissions.
- Increased aerial leak detection and more widespread use of sensitive leak detection equipment on transmissions pipelines.
- Expanded efforts in the use of drafting and cross compression to reduce blowdowns emissions from transmission assets.
- Reduced the amount of farm taps regulator sets deemed obsolete under PG&E's 2KA Program.
- Reduced high bleed pneumatic devices from transmission M&R Stations.

- Converted other pneumatics in transmissions compressors and underground storage to use air instead of gas, which resulted in slight emissions reductions for the component sector.
- Performed quarterly comprehensive leak surveys required by the COGR. The change to quarterly leak surveys from annual surveys at its Underground Storage Facilities identified an additional 686 component leaks for an 116% YOY increase.
- The average number of days leaking for leaks discovered through the increased survey frequency decreased by approximately 50% YOY due to the additional surveys and repairs performed each quarter.

Southern California Gas

Southern California Gas Company (SoCalGas) is the state's second largest gas utility and reported emissions totaling 2,543,548 Mscf in 2018, a decrease of 152,963 Mscf (6%) from the 2,696,512 Mscf reported in 2017. The reduction in 2018 emissions can be attributed to a variety of Best Practice implementations throughout the company.

The most significant efforts undertaken in 2018 are listed below:

- Began annually surveying pre-1986 Aldyl-A mains and services (previously on a 5-year survey cycles).
- Increased the rod packing replacement frequency in compressors by installing 13 packing replacements at Transmission Compressor Stations and 14 packing replacements at Storage facilities.
- Reduced line pressure before blowdowns, which avoided an estimated 1,450 Mscf of emissions
- Continued implementing a methane capture system that compressed pipeline gas into a compressed natural gas tube trailer and then re-introduced the gas into the pipeline. This further reduced methane emissions by an additional 800 Mscf.
- Replaced 104 miles of non-state-of-the-art pipe, including 29 miles of unprotected steel and 75 miles of early vintage plastic pipe. An annual reduction of 1,000 Mscf is anticipated from the pipeline replacements.
- Updated the above ground leak repair policy to repair all distribution above ground minor leaks within 10 days of discovery.
- Increased spending on media for awareness campaigns aimed at individuals that promotes calling 811 before digging. The expanded awareness campaign is believed to have reduced the YOY total number of excavation damages in 2018.

- Conducted research projects in EFs, leak detection, leak quantification, damage prevention, geographic tracking and integrity risk factors, blowdowns and pipeline safety.
- Began developing a leak quantification method to identify and prioritize Grade 2 and Grade 3 leaks with leak rates greater than 10 cubic feet per hour (CFH). This method is being piloted at three distribution bases to evaluate the data model and determine best processes for full scale implementation, which are expected to begin in 2020.
- Replaced three high-bleed pneumatic devices in 2018 out of the nine remaining on the system targeted for replacement, and subsequently replaced a further 4 devices in 2019 that will further reduce emissions for calendar year 2019.

San Diego Gas and Electric

San Diego Gas & Electric (SDG&E) is the state's third largest utility and reported emissions totaling 253,658 Mscf for 2018, a decrease of 3,136 Mscf (1%) from the 256,794 Mscf reported in 2017. As SDG&E and SoCalGas operate under Sempra Energy, both utilities share similar practices and efforts in reducing emissions. SDG&E continued implementing its Best Practices detailed in the 2018 Compliance Plan and incorporated these policies throughout its operations. The most significant efforts undertaken by the utility in 2018 are listed below:

- Began preparing to transition to a 3-year leak survey interval from a five-year leak survey on protected steel and plastic pipes by hiring and training incremental employees, purchasing tools, vehicles, and instrumentation, coordinating facility requirements, and updating compliance systems.
- Replaced approximately 40 miles of non-state of the art early vintage plastic pipe, which reduced emissions by approximately 38 Mscf of annual emissions.
- Began performing annual leak surveys on pre-1986 Aldyl-A mains and associated services, compared with the previous 5-year leak survey cycles. The emissions reductions expected for this activity are detailed in the 2018-2019 Leak Abatement Compliance Plan.
- Reduced line pressure before blowdowns which avoided 88.7 Mscf of emissions

- Performed field verifications, which confirmed that no high-bleed pneumatic devices exist in the system and all have been proactively replaced.
- Engaged in a research project on the quality of threaded fitting in the system.
- Began designing the scope of an internal study to determine if more stringent quality control processes need to be implemented to reduce emissions through threaded fittings.
- Conducted research projects in 2018 in the following areas: EFs, leak detection, leak quantification, damage prevention, blowdowns and pipeline safety & integration.

Southwest Gas

Southwest Gas (SWG) is the state's fourth largest utility and reported emissions totaling 217,540 Mscf for 2018, which increased by 4,964 Mscf (2%) from the 212,575 Mscf reported in 2017. The increase in emissions was mainly due to the reclassification of seven Distribution Stations as Transmissions M&R Stations in 2018. The seven stations contained enough transmissions rated components that CPUC/SED and SWG representatives agreed to the reclassification. The population emission factor for a Transmissions M&R Station is much larger than a distribution station and as a result, emissions increased by 10,883 Mscf for this source category. This increase was offset by decreases in Distribution M&R emissions, DM&S and MSA damages, and blowdowns.

SWG does not have many leaks on its pipeline network and surveys its distribution system over a 3-year cycle, while some portions of its system are surveyed annually (e.g. business districts and PVC pipe). In addition, SWG has not experienced large YOY fluctuations in emissions. In 2018, the utility also:

- Implemented a 3-year repair cycle for Grade 3 leaks
- Retired 12 distribution M&R stations while adding 3 new stations, which reduced emissions by 3,721 Mscf from 2017.
- Reduced Distribution Main and Services blowdowns by 41% with a corresponding emissions reduction of 842 Mscf (91%) from 2017 where in 2017 one blowdown equated to 86% of the blowdown emissions. There were no large blowdowns in 2018.

Wild Goose Gas Storage

Wild Goose Storage (WGGS) reported emissions of 21,248 Mscf in 2018, which increased by 3,493 Mscf (20%) from the 17,755 Mscf reported in 2017. The

implementation of the COGR identified additional leaks compared to 2017, adding 2,014 Mscf along with increased O&M blowdown activity of 1,921 Mscf largely making up all the increases in 2018.

Gill Ranch Gas Storage

Gill Ranch Gas Storage (GRGS) reported emissions of 16,084 Mscf for 2018, which increased by 10,989 Mscf from the 5,094 Mscf reported in 2017. Two things drive this apparent increase: 1) 4,865 Mscf of the increase is due to a 50% increase in O&M blowdown activity; and 2) in prior years direct measurement of compressor emissions did not occur. Where had we used the compressor operating EFs from 2018 as proxies for prior year EFs (assuming the same emissions profiles) the 2017 compressor emissions would have been about 6,110 Mscf, which would account for the apparent increase in 2018. Implementing the COGR was instrumental in improving GRGS's estimation of 2018 emissions as well as providing a better understanding and determining under reporting of prior year emissions.

Lodi Gas Service

Lodi Gas Service (LGS) reported emissions of 2,814 Mscf for 2018. The utility decreased its emissions by 2,833 Mscf (51%) from the 5,697 Mscf reported in 2017. The large decrease resulted from fixing pipeline leaks in 2017 that eliminated 2,248 Mscf of 2017 emissions, as well as additional reductions of 553 Mscf by implementing the quarterly COGR surveys and using leaker EFs rather than population based EFs to estimate facility emissions.³³

Central Valley Gas Storage

Central Valley Gas Storage (CVGS) reported emissions of 1929 Mscf for 2018, an increase of 1,459 Mscf from the 469 Mscf reported in 2017. Although initially the increase in emissions seems rather large, it is important to mention that in April 2018 CVGS installed vent line meters in order to determine the actual emissions past the compressor rod packing during pressurized operating and idle hours. Previously, CVGS estimated that the emissions were minimal, but after discussions with Staff and the compressor manufacturer, the utility procured and installed the vent line meters.

³³ Note that LGS reported its transmission pipeline leaks using better estimates of the leaks found and fixed rather than taking the EF per mile estimate, which would have resulted in significantly less reported emissions. Because they have a relatively short transmission line Staff approved using the more conservative approach to provide a more reasonable estimate of emissions.

As a result, they found that emissions past the compressor rod packing were much larger and primarily the reason for its 2018 YOY increase. The direct measurement of these emissions indicates that prior year emissions were understated since there has not been any change in operations or assets before installing the meters. Staff will evaluate the 2018 data to determine whether it warrants a change to CVGS's baseline.

West Coast Gas

West Coast Gas (WCG) is a small natural gas supplier and distribution utility with reported emissions of 260 Mscf for 2018, and reported a 161 Mscf or 38% reduction from the 422 Mscf 2017 emissions.³⁴ The reduction of 161 Mscf YOY was a direct result of a reduction in pipeline leaks between the two calendar years.

Alpine

Alpine gas storage reported emissions of 253 Mscf in 2018, an increase of 9 Mscf from the 244 Mscf reported in 2017. The utility's emissions remain relatively constant YOY with a few additional pipeline leaks and pipeline damages due to accidental dig-ins which accounted for the slight increase in emissions.

Detailed Emissions by Category, Source and Classification

The next section discusses the emissions by system categories, emission source, and source classification. Table 7 provides a comprehensive and detailed emission inventory for 2015, 2017, and 2018 calendar years.

Table 7 summarizes information from the templates, where common items may be combined or regrouped as done in 2017. Because the reporting templates also include items reported for informal purposes, Table 7 does not report all line item categories as reported in the templates. For example, in the M&R Station template the Component Leaks are included in the EF used to report M&R Station emissions, and therefore, not included separately to prevent duplication in the emissions inventory. For the line items in the Transmission Compressor template, Compressor Leaks and Component Leaks have been combined in the table.

New to 2018 are the separation of the Customer Meter – Damages from DM&S – Damages, which in prior years were combined because not all respondents distinguish between the two sources. This line item will be used going forward, though the 2017

³⁴ The 2018 Joint Report incorrectly reported WCG's total 2017 emissions as 472 Mscf, which overstated WCG's emissions by 50 Mscf due to an inadvertent typographical error that occurred producing the 2018 report.

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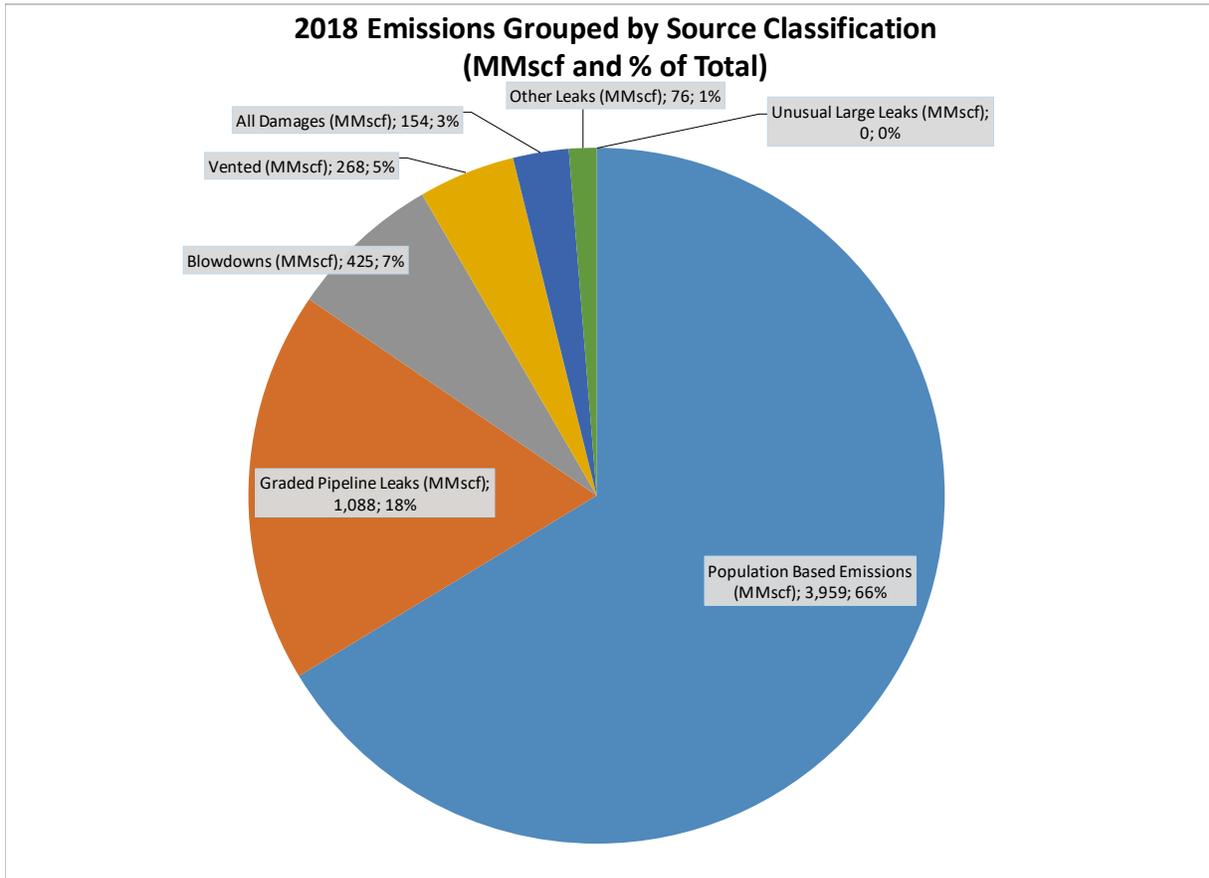
DM&S and Customer Meter Damages do not include damages from PG&E, thus are not directly comparable to the 2018 damages.³⁵

Table 7: Detailed Emissions (Category, Source, and Classification) 2015, 2017-2018

Emission Source	Source Classification	2015 Baseline	2017	2018	2015 Baseline to 2018 Change		2017 - 2018 YOY Change	
		Mscf	Mscf	Mscf	Mscf	%	Mscf	%
Pipeline Leaks	Population Based	5,238	7,239	5,102	(136)	(3%)	(2,137)	(30%)
All Damages	Damages	81,793	16,671	4,171	(77,622)	(95%)	(12,500)	(75%)
Blowdowns	Blowdown	455,055	465,418	297,494	(157,561)	(35%)	(167,923)	(36%)
Component Emissions	Vented	4,592	12,756	35,433	30,841	672%	22,677	178%
Odorizers	Vented	2,570	2,496	2,673	103	4%	177	7%
Station Leaks & Emissions	Vented	941,622	929,454	945,585	3,963	0.4%	16,131	2%
Blowdowns	Blowdown	65,583	84,936	28,431	(37,152)	(57%)	(56,504)	(67%)
Component Emissions	Vented	21	-	-	(21)	(100%)	-	N/A
Compressor Emissions	Vented	106,257	65,659	84,588	(21,669)	(20%)	18,929	29%
Blowdowns	Blowdown	31,088	45,780	62,396	31,308	101%	16,616	36%
Component Emissions	Vented	7,186	15,360	24,039	16,853	235%	8,680	57%
Component Leaks	Other Leaks	18,153	25,139	26,521	8,368	46%	1,382	5%
Storage Tank Leaks & Emissions	Other Leaks	3	395	332	329	10,976%	(62)	(16%)
Pipeline Leaks	Pipeline Leaks	1,458,399	1,206,832	1,087,858	(370,541)	(25%)	(118,974)	(10%)
All Damages	Damages	236,145	183,718	118,516	(117,629)	(50%)	(65,202)	(35%)
Blowdowns	Blowdown	5,046	2,847	1,220	(3,826)	(76%)	(1,627)	(57%)
Component Emissions	Vented	3,281	-	-	(3,281)	(100%)	-	N/A
Component Leaks	Other Leaks	0	142	2,934	2,934	N/A	2,792	1,963%
Station Leaks & Emissions	Population Based	1,347,773	1,333,904	1,350,171	2,398	0.2%	16,266	1.2%
Blowdowns	Blowdown	295	333	356	61	21%	23	7%
All Damages	Damages	-	72	44	44	N/A	(28)	(39%)
Meter Leaks	Population Based	1,635,911	1,654,910	1,658,637	22,726	1.4%	3,727	0.2%
All Damages	Damages	-	26,843	31,683	31,683	N/A	4,840	18%
Vented Emissions	Vented	2,363	1,576	1,277	(1,086)	(46%)	(299)	(19%)
Storage Leaks & Emissions	Other Leaks	15,016	7,577	7,470	(7,546)	(50%)	(107)	(1.4%)
Compressor Emissions	Vented	96,313	48,266	32,517	(63,796)	(66%)	(15,750)	(33%)
Blowdowns	Blowdown	46,358	35,632	34,918	(11,440)	(25%)	(714)	(2%)
Component Emissions	Vented	14,947	95,748	87,399	72,452	485%	(8,348)	(9%)
Compressor & Component Leaks	Other Leaks	-	45,786	38,740	38,740	N/A	(7,046)	(15%)
Dehydrator Vent Emissions	Vented	20,163	12	14	(20,149)	(100%)	1	11%
Leaks and Emissions		-	83,000	-	-	N/A	(83,000)	N/A
		6,601,171	6,398,499	5,970,520	(630,651)	(9.6%)	(427,980)	(6.7%)

³⁵ PG&E's reported 6,375 Mscf MSA-Damages in 2018. There is no comparable amount for 2017 where these damages are still included in the DM&S – Damages. To the extent that 2017's MSA – Damages are like those reported in 2018, then the 2007 MSA – Damages would be understated by that amount and conversely, the DM&S – Damages would be overstated by the same amount.

Figure 2: Emissions Grouped by Source Classification, 2018



Grouping the system emissions by source classification resulted in the following observations:

1. The Population Based Leaks make up 66% of the total 2018 emissions as shown in Figure 2.³⁶
2. The 2018 Graded Pipeline Leak emissions make up 18% or about a fifth of total emissions and had a significant 10% decrease from 2017 of 119 MMscf.³⁷
3. Though Blowdowns make up 7% of 2018 total emissions at 425 MMscf, they accounted for the greatest amount of YOY decrease of 211 MMscf or 33%. Because Blowdown emissions are correlated with O&M activity, we expect YOY fluctuations, however, over time we should see a decreasing trend due to implementation of best practices.
4. The Damages classification also has a large YOY 32% or 73 MMscf decrease attributed to expanded public outreach to call “811” before digging.

³⁶ See Table 3: Total Emissions by Source Classification, 2015 – 2019.

³⁷ Ibid

5. The Vented emissions category had the largest YOY increase on a percentage basis at 11%, but overall the emission increase was relatively minor at 26 MMscf in large part attributed to the COGR implementation, and increased compressor operations.
6. The Other Leaks category had a minor decrease of 3 MMscf or 4%.
7. There were no Unusual Large Leaks in 2018, in contrast to 2017, which experienced 3 unusual large leaks totaling 83 MMscf.

Table 8 shows the detail composition of Blowdowns. The Blowdowns classifications experienced significant decreases from 2017 as well as the 2015 baseline emissions, primarily due to reduced O&M activity, project bundling and cross pressurization practices.

Table 8: Blowdown by Systems Category, 2015, 2017-2018

System Category	2015 Baseline [Mscf]	2017 [Mscf]	2018 [Mscf]	2015 Baseline to 2017 Change		2017 - 2018 YOY Change	
				Mscf	%	Mscf	%
Blowdowns							
Transmission Pipelines	455,055	465,418	297,494	(157,561)	(35%)	(167,923)	(36%)
Transmission M&R Stations	65,583	84,936	28,431	(37,152)	(57%)	(56,504)	(67%)
Transmission Compressor Stations	31,088	45,780	62,396	31,308	101%	16,616	36%
Distribution Mains and Services	5,046	2,847	1,220	(3,826)	(76%)	(1,627)	(57%)
Distribution M&R Stations	295	333	356	61	21%	23	7%
Underground Storage	46,358	35,632	34,918	(11,440)	(25%)	(714)	(2%)
Total-Blowdowns	603,425	634,945	424,815	(178,610)	(30%)	(210,130)	(33%)

Table 9 shows the detail composition of vented emissions. There is significant variability between the vented emissions in the Transmission Compressor Stations and Underground Storage Facilities, where the implementation of the COGR affected each respondent differently, in some cases it resulted in greater and for others decreased YOY reported emissions. The reasons are complicated and specific to each respondent (see the section: Summary of Gas Company Emissions). Generally, transmission compressor operations increased during 2018 resulting in increased emissions. On the other hand, the overall emissions in storage facilities decreased due to less compressor activity, and better estimates of emissions from direct measurement.

Table 9: Vented Emissions by Systems Category, 2015, 2017-2018

System Category	2015 Baseline [Mscf]	2017 [Mscf]	2018 [Mscf]	2015 Baseline to 2017 Change		2017 - 2018 YOY Change	
				Mscf	%	Mscf	%
Vented Emissions							
Transmission Pipelines, Components	4,592	12,756	35,433	30,841	672%	22,677	178%
Transmission Pipelines, Odorizers	2,570	2,496	2,673	103	4%	177	7%
Transmission M&R Stations, Components	21	-	-	(21)	(100%)	-	-
Transmission Compressors Stations, Compressors	106,257	65,659	84,588	(21,669)	(20%)	18,929	29%
Transmission Compressors Stations, Components	7,186	15,360	24,039	16,853	235%	8,680	57%
Distribution Mains & Services, Components	3,281	-	-	(3,281)	(100%)	-	-
Customer Meters, Vented	2,363	1,576	1,277	(1,086)	(46%)	(299)	(19%)
Underground Storage, Compressors	96,313	48,266	32,517	(63,796)	(66%)	(15,750)	(33%)
Underground Storage, Components	14,947	95,748	87,399	72,452	485%	(8,348)	(9%)
Underground Storage, Dehydrator Vent	20,163	12	14	(20,149)	(100%)	1	11%
Total-Vented Emissions	257,693	241,872	267,940	10,247	4%	26,068	11%

Detailed Discussion for Each of the Seven Systems Categories

Transmission Pipeline:

PG&E, SoCalGas, SDG&E, Lodi Gas Storage (LGS), and Central Valley Gas Storage (CVGS) reported Transmission Pipeline Emissions; the transmission system category has shown considerable reductions in emissions over the past year. The decrease in total emissions from 509,079 Mscf in 2017 to 323,064 Mscf in 2018 was primarily due to 189,732 Mscf decrease in blowdown activity. Utilities have informed Staff that blowdowns are cyclical in nature where we expect variability due to maintenance activity levels. (See company summaries above for more detail.)

Table 10: Transmission Pipeline Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Pipeline Leaks	5,238	1%	7,239	1%	5,102	1%	(2,137)	(30%)
All Damages	81,793	15%	16,671	3%	4,171	1%	(12,500)	(75%)
Blowdowns	455,055	83%	465,418	92%	297,494	86%	(167,923)	(36%)
Component Emissions	4,592	1%	12,756	3%	35,433	10%	22,677	178%
Odorizers	2,570	0%	2,496	0%	2,673	1%	177	7%
Total	549,248	100%	504,579	100%	344,873	100%	(159,706)	(32%)

- The Transmission Pipeline Leaks category decreased 2,137 Mscf (30%) from 7,239 Mscf in 2017 to 5,102 Mscf in 2018. Typically, emissions for this category have remained constant because the emissions are based on the miles of transmission pipeline, which does not vary much YOY. However, in 2017 LGS reported two large transmission pipeline leaks on their short section of pipe using actual estimated emissions rather than using the Population EF (a per mile of pipe EF) for their pipeline emissions. The actual leak emissions of 2,128 Mscf was included in 2017 transmission pipeline emissions.³⁸
- In 2018 All Damages decreased by 12,500 Mscf (75%) to 4,171 Mscf. The primary reason for the YOY decrease was due to 12 fewer damages and 14,413 Mscf less emissions experienced by PG&E. These emissions are event based could fluctuate significantly from year-to-year. Though utilities implemented best practices to reduce pipeline dig-ins (Best Practice 24), the efficacy of their programs will become evident over time.
- Blowdowns showed significant YOY reductions of 167,923 Mscf (36%) from 465,418 Mscf in 2017 to 297,494 Mscf in 2018. There are several factors acting on blowdowns and the potential for YOY fluctuations (e.g. the cyclical nature of O&M, ability to bundle projects, the amount of pipeline replacement, the size, length and pressure of the pipelines affected, and number of safety events). In 2018 both SoCalGas's YOY reduction of 23,495 Mscf and PG&E's YOY reductions of 133,307 Mscf were due to the types of projects performed and increased effort to abate blowdown emissions.
- Component Emissions category increased 22,677 Mscf (178%) from 12,756 Mscf to 35,433 Mscf in 2018. The increase was primarily due to PG&E, who had a YOY increase of 23,471 Mscf an increased inventory of components (81) arising from improvements to its transmission pipeline asset reporting system. SoCalGas had a smaller decrease of 794 Mscf due to better asset field verification and the replacement of emitting components.
- The Odorizer emissions remained relatively constant because it is based on throughput which doesn't change significantly YOY, even though PG&E added 38 and SoCalGas added 9 odorizers.

³⁸Staff approved reporting the LGS emissions estimates because it represented the most reasonable estimate of their 2017 emissions. These leaks did not warrant classification as Unusual and Large.

Transmission M&R Stations:

PG&E, SoCalGas, SDG&E, SWG, and Central Valley Gas Storage reported total Transmission M&R Station Emissions of 974,017 Mscf in 2018. This category of emissions is largely population based, except for the blowdowns, which are activity based.³⁹ As a result M&R station emissions will be relatively constant over time unless the population changes significantly or changes to the EF. For example, the 4-year average Transmission M&R Station emissions is 937,000 Mscf, where 2018's emissions of 945,585 Mscf is only 8,600 Mscf (4%) greater than the average, and attributed to normal changes in the population of M&R stations.⁴⁰ Specific impacts on emissions include PG&E's YOY reduction of 21,695 Mscf due to the reduced number of farm taps and small changes to station counts. SoCalGas's YOY increase of 944 stations resulted in an increase of 26,943 Mscf. SWG's YOY increase of 7 stations and 10,883 Mscf due to reclassification from distribution M&R stations. (See company summaries above for more detail.)

As noted in Table 11 below, the 2018 Blowdowns were 3% of category emissions and decreased 56,504 Mscf (67%) YOY. In 2018 PG&E recorded its blowdown emissions using a different methodology based on estimates based on the event, which resulted in the 59,132 Mscf YOY decrease even with an 18% increase in blowdown events.⁴¹ Staff reviewed and approved this methodological change based on actual measurement.

³⁹ Population based emissions in this category are calculated based on the number of M&R stations multiplied by an EF to obtain the emission estimate.

⁴⁰ The 4-year average includes 2016 and is based on the following: 2015 - 941,622Mscf, 2016 - 931,280Mscf, 2017 - 929,454Mscf, and 2018 - 945,585Mscf.

⁴¹ The 2018 emission estimates utilize a technique, which accounts for the chamber volume, pressure, and temperature of the gas at the time of the gas release pursuant to the requirements for 40 CFR Part 98, Subpart W greenhouse gas (GHG) reporting. Note that blowdowns where the chamber volume is less than 50 scf were not included, as discussed on page 12 of the narrative report. This technique allows PG&E to be more specific about blowdown volumes and utilize tracked data that was, for the first time in the 2018 emission year, granular enough to interpret, which gas release events happened at transmission M&R stations as opposed to relying on an industry-wide emission factor. Staff reviewed and approved this methodological change based on actual measurement.

Table 11: Transmission M&R Station Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Station Leaks & Emissions	941,622	93%	929,454	92%	945,585	97%	16,131	2%
Blowdowns	65,583	7%	84,936	8%	28,431	3%	(56,504)	(67%)
Component Emissions	21	0%	-	0%	-	0%	-	NA
Total	1,007,226	100%	1,014,390	100%	974,017	100%	(40,373)	(4%)

There were no reportable component emissions in 2017 or 2018 because M&R station EF already takes this source of emissions into account. This line item is an artifact of inadvertently including component emissions that were reported for informational purposes in 2015. The 21 Mscf included in 2015 will be omitted at the same time that the 2015 Baseline adjustments are made.

Transmission Compressors:

PG&E, SoCalGas, and SDG&E reported 2018 total Transmission Compressor Station Emissions of 197,877 Mscf, which is a 45,544 Mscf (30%) increase from 2017 emissions of 152,333 Mscf (see Table 12 below). (See company summaries above for more detail.)

Table 12: Transmission Compressor Station Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Compressor Emissions	106,257	65%	65,659	43%	84,588	43%	18,929	29%
Blowdowns	31,088	19%	45,780	30%	62,396	32%	16,616	36%
Component Emissions	7,186	4%	15,360	10%	24,039	12%	8,680	57%
Compressor and Component Leaks	18,153	11%	25,139	17%	26,521	13%	1,382	5%
Storage Tank Leaks & Emissions	3	0.0%	395	0.3%	332	0.2%	(62)	(16%)
Total	162,687	100%	152,333	100%	197,877	100%	45,544	30%

The sub-category Compressor Emissions increased 18,929 Mscf (29%) from 65,659 Mscf in 2017 to 84,588 Mscf in 2018. PG&E experienced a 10,160 Mscf increase due to higher level of pressurized run hours to increase throughput to meet demand. SoCalGas's 8,189 Mscf increase was largely affected by increased emissions from worn compressor rod packing at one facility.

The Blowdowns increased 16,616 Mscf (36%) from 45,780 Mscf in 2017 to 62,396 Mscf in 2018. PG&E noted their YOY increase of 17,603 Mscf was due to increased blowdown volumes due to leak repair activity at Hinkley, Kettleman and Topock Compressor Stations. PG&E commissioned new compressors at both Burney and Gerber Compressor Stations adding to blowdowns in 2018.⁴²

The Component Emissions was affected by the comprehensive leak surveys required by the COGR increasing 8,680 Mscf (57%) from 15,360 Mscf in 2017 to 24,039 Mscf in 2018.

The overall emissions for Transmission Compressor Stations - Component Leaks of 26,521 Mscf, which increased slightly YOY from 25,139 Mscf in 2017. PG&E noted a 686-leak increase, and a corresponding increase of 1,441 Mscf. PG&E also differentiated the compressor and non-compressor component leaks at transmission compressor stations because each uses a different emission factor. SoCalGas had a similar 628-leak increase, but their emissions decreased by 1,991 Mscf. In general, the COGR has had the effect of reducing individual leak emissions through more stringent leak detection thresholds (leaks smaller on average) and quarterly surveys at Compressor Stations and Underground Storage Facilities that result in shorter average leak durations. The reductions in the average individual leak are offset by the cumulative emissions from the increased number of leaks being detected.

Storage Tank Leaks and Emission decreased from 395 Mscf in 2017 to 332 Mscf in 2018.

Distribution Mains and Services (DM&S):

PG&E, SoCalGas, SDG&E, SWG, West Coast Gas Company (WCGC) and Alpine reported total DM&S Emissions of 1,210,527 Mscf in 2018, which is a total decrease of 183,011 Mscf or a 13% reduction from 2017's total of 1,393,539 Mscf (see Table 13).

⁴² The 2017 Underground Storage – Compressor Blowdown emissions were mistakenly included by GRGS in Transmission Compressor Blowdown emissions. These were moved to the Underground Storage Facility - Blowdown category in this year's report to properly match with 2018 blowdown emissions.

Table 13: Distribution Mains and Services (DM&S) Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Pipeline Leaks	1,458,399	86%	1,206,832	87%	1,087,858	90%	(118,974)	(10%)
All Damages	236,145	14%	183,718	13%	118,516	10%	(65,202)	(35%)
Blowdowns	5,046	0.3%	2,847	0.2%	1,220	0.1%	(1,627)	(57%)
Component Emissions	3,281	0.2%	-	0%	-	0%	-	NA
Component Leaks	-	0%	142	0.01%	2,934	0.2%	2,792	1,963%
Total	1,702,871	100%	1,393,539	100%	1,210,527	100%	(183,011)	(13%)

The emissions from DM&S Pipeline Leaks showed a significant decrease of 118,974 Mscf (10%) from 2017 to 2018. The decrease is primarily due to variations between the current and past areas surveyed, and the rate at which system leaks develop in areas surveyed within SoCalGas’s service territory, and annually surveying vintage pipeline material amounting to a YOY reduction of 111,377 Mscf. The adoption of an annual survey protocol for vintage plastic pipelines results in a decrease in the projected number of Unknown Leaks because all vintage plastic leaks are surveyed and detected on an annual basis.

While PG&E did not have as large a YOY reduction in the DM&S category, with a net reduction of 6,804 Mscf. Of this reduction, 87,929 Mscf is due to their “Super Emitter” (SE) protocol initiated in the later part of 2018, which was offset by larger emissions due to an increase in the number of leaks found by shortening the survey cycle to 3-years. This protocol should show more emission reductions when operated for a full year, as well as the 3-year survey cycle as it goes through its second and third years of operation. Finally, PG&E used special vintage material surveys to separate the type of leaks that occur with this material from the standard calculation of Unsurveyed leaks. (See company summaries above for more detail.)

The All Damages category decreased 65,202 Mscf (35%) from 183,718 Mscf in 2017 to 118,516 Mscf in 2018.⁴³ The majority of this decrease was due to PG&E’s YOY reduction of 68,151 Mscf that resulted from refined calculation methodology that uses the gas shut-off time for damages lasting less than one day. In prior years the emissions from damages using the old less precise method of accounting were likely overstated

⁴³ The above ground damages associated with MSA’s that was included in the 2017 balance totaling 23,901 Mscf was deducted from the 2017 DM&S damages and transferred to 2017 MSA damages to match up with the 2018 damages.

and that this change in accounting is not correlated with actual emission reductions. Also, beginning in 2018, PG&E was able to identify the number of All Damages and associated emissions on MSA's of 6,375 Mscf (reported under Appendix 6) that were previously included in this category in prior reporting years and which have now been recategorized as MSA – All Damages.⁴⁴

Blowdowns showed a decrease of 1,627 Mscf in 2018 from 2,847 Mscf to 1,220 Mscf.

There were 3,281 Mscf of Component Emissions (vented) reported in 2015, while none have been reported since.⁴⁵

The Component Leaks (fugative) showed a significant percentage increase of 1,963% from 142 Mscf in 2017 to 2,934 Mscf in 2018 due solely to SoCalGas's reported increase in leaking components from 2017 to 2018. Based on this finding SoCalGas performed further analysis during the Draft Report review period, where SoCalGas identified differences between its categorization of Component Leaks in 2017 and 2018.

To ensure that all reporting entities are reporting component leaks on a consistent basis the definition of Component Leaks will be reviewed at the January 2020 workshop. Staff needs to analyze whether any adjustments are needed in this category in prior years.

Detailed Discussion of DM&S Leaks and Emissions:

The data provided by respondents include leak discovery date, repair date, leak grade, pipeline classification as either main or service, pipeline material, method of discovery, and emissions calculation. Respondents also provided other parameters for informational purposes that were not used in any calculations, such as zip code location of leak, pipe size, pressure, and scheduled date of repair.

Table 14 shows each of the leak Grades 1 – 3, Unsurveyed leaks, and Above Ground (AG) Non-Hazardous leaks. This is the first year that there were no Above Ground (AG) Non-Hazardous leaks. Unsurveyed leaks are estimated based on respondent's leak rate, and as such, Staff does not proportionately allocate the un-

⁴⁴ The MSA -Damages reported by other entities in 2017 have been reclassified to match 2018 reporting.

⁴⁵ The 2015 balance of DM&S Component Emissions is an artifact of inadvertently including Component emissions provided for informational purposes and represents duplicating emissions either included in Distribution M&R Station EFs, or MSA EFs. The 2015 balance will be evaluated for adjustment at the same time we make the of 2015 Baseline adjustments.

surveyed leaks by the proportion of Graded leaks found in respondent’s service territory.

Grade 3 leaks make up most of the DM&S leaks (20,535). A significant amount of the Grade 3 leaks carryover from previous years. While the estimated un-surveyed leaks cannot be graded, these leaks make up 35% of the leak inventory by count.

Table 15 shows that Grade 1 leaks are repaired quickly, taking a weighted average of 3.3 days to fix. There is more variability in the average time to repair Grade 2 and 3 leaks where smaller utilities, such as SDG&E, SWG, WCGC, have shorter average repair times.

Table 14: Calculated Emissions Volume by Leak Grade in 2018

Leak Grade	Natural Gas Leaks				Total	%
	Carried Over	Discovered in 2018	Repaired in 2018	Estimated Unsurveyed		
Grade 1	31	8,220	(7,989)	-	262	1%
Grade 2	1,080	4,462	(3,712)	-	1,830	5%
Grade 3	15,676	11,877	(7,018)	-	20,535	59%
Unsurveyed - No grade	-	-	-	12,181	12,181	35%
Above Ground - Hazardous	-	-	-	-	-	0%
Above Ground - Non-Hazardous	-	-	-	-	-	0%
Total	16,787	24,559	(18,719)	12,181	34,808	100%

Table 15: Average Days to Repair by Entity, 2018⁴⁶

Entity	Average Repair Days		
	Grade 1	Grade 2	Grade 3
PG&E	5	165	981
SCG	1	187	972
SDG&E	1	4	8
SWG	1	3	41
WCG	-	-	200
Weighted Average	3.3	166	968

⁴⁶ PG&E calculates its Average Repair Days based on the original discovery date, where leaks initial grade may not require immediate repair such as a Grade 3 leak, when it gets subsequently regraded to a higher grade the repair prioritization changes per the requirements for the new grade. However, the average number of days to repair does not account for the leak regrade date. Therefore, it does not take many regraded old Grade 3 leaks to skew the overall average time to repair.

Distribution M&R Stations:

PG&E, SoCalGas, SDG&E, SWG and Alpine reported emissions in this category of 1,350,571 Mscf, a 16,262 Mscf (1.2%) increase from the 2017 total of 1,334,309 Mscf (see Table 16). Except for Blowdowns and All Damages, the emissions in this category are based on the number of M&R stations multiplied by a corresponding EF. The small YOY changes result from better reporting of facility types, and commissioning and decommissioning M&R stations. In general, there is not much YOY variability with the last two years showing only 1.2%. (See company summaries above for more detail.)

Table 16: Distribution M&R Stations Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Station Leaks & Emissions	1,347,773	100%	1,333,904	100%	1,350,171	100%	16,266	1.2%
Blowdowns	295	0%	333	0%	356	0%	23	7%
All Damages	-	0%	72	0%	44	0%	-28	(39%)
Total	1,348,068	100%	1,334,309	100%	1,350,571	100%	16,262	1.2%

Customer Meters:

PG&E, SoCalGas, SDG&E, SWG, WGGs, and Alpine reported Customer Meter emissions totaling 1,691,598 Mscf increasing 35,112 Mscf (0.5%) from 1,683,329 Mscf in 2017, see Table 17. (See company summaries above for more detail.)

Table 17: Customer Meter Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Meter Leaks	1,635,911	100%	1,654,910	98%	1,658,637	98%	3,727	0.2%
All Damages	N/A	N/A	26,843	1.6%	31,683	1.9%	4,840	18%
Vented Emissions	2,363	0.1%	1,576	0.0%	1,277	0.1%	(299)	(19%)
Total	1,638,274	100%	1,683,329	100%	1,691,598	100%	8,269	0.5%

Overall, the customer meters category has the largest share of the total emissions at 28%, and once again comprises the largest share of population-based emission estimates for the 2018 reporting year. MSA emissions are not expected to fluctuate widely YOY because they are based on an EF applied to the number of meter sets.⁴⁷

The All Damages category was added in 2018 and shows 2018 emissions of 31,683 Mscf with 26,843 Mscf for 2017. The MSA damages reported in 2017, and prior years, were included with DM&S damages because at the time PG&E did not have the tools to bifurcate the MSA and DM&S damages. Staff added this category of emissions to this report in 2018 because PG&E was able to report this type of emissions in 2018 after evolving their databases and data management systems that differentiate between the damages on above ground DM&S pipelines and MSA system assets. Note that because PG&E cannot report 2017 MSA damages separately, the YOY difference of 4,840 Mscf appears to be largely due to the absence of PG&E MSA damages. Where, if PG&E's 2018 MSA damages of 6,375 Mscf were comparable to 2017's, then that would account for most of the difference. The rest of the difference is due to annual fluctuation.

Although Vented Emissions are relatively insignificant at 1,277 Mscf in 2018, this emission source decreased by 299 Mscf (19%) from 2017. These blowdown emissions are a function of O&M activity levels and vary YOY depending on type of work performed.

Underground Storage:

PG&E, SoCalGas, CVGS, GRGS, LGS, and Wild Goose Storage (WGGG) reported Underground Storage systems emissions for 2018. As seen in Table 18 below, Underground Storage emissions decreased 31,964 Mscf (14%) from 233,022 Mscf in 2017 to 201,058 Mscf in 2018.

⁴⁷ Currently, the gas companies provide their actual MSA leaks found on their systems in their annual filings on an information only basis. In the future, it may be possible at some time in the future to use actual MSA leak survey data to estimate MSA emissions by extrapolating MSA survey leaks on the same basis as that used for DM&S pipeline leaks.

Table 18: Underground Storage Emissions, 2015, 2017-2018

Source	2015 Baseline		2017		2018		2017 - 2018 YOY Change	
	Mscf	%	Mscf	%	Mscf	%	Mscf	%
Storage Leaks & Emissions	15,016	8%	7,577	3.3%	7,470	3.7%	(107)	(1%)
Compressor Emissions	96,313	50%	48,266	21%	32,517	16%	(15,750)	(33%)
Blowdowns	46,358	24%	35,632	15%	34,918	17%	(714)	(2%)
Component Emissions	14,947	8%	95,748	41%	87,399	43%	(8,348)	(9%)
Compressor and Component Leaks	-	0%	45,786	20%	38,740	19%	(7,046)	(15%)
Dehydrator Vent Emissions	20,163	10%	12	0.0%	14	0.0%	1	11%
Total	192,797	100%	233,022	100%	201,058	100%	(31,964)	(14%)

The Storage Leaks and Emissions decreased 107 Mscf (1%) YOY from 7,577 Mscf in 2017 to 7,470 Mscf in 2018. Part of the decrease resulted from SoCalGas making refinements to their 2018 data that more precisely calculated leak duration than previous years that were based on a 5-day average leak duration. (See company summaries above for more detail.)

The Compressor Emissions decreased by 15,750 Mscf (33%) primarily due to SoCalGas's YOY reduced operating hours and associated reduced emissions of 21,529 Mscf.

The Blowdown emissions decreased by 714 Mscf (2%) from 35,632 Mscf in 2017 to 34,918 Mscf in 2018 primarily to decreases at PG&E and SoCalGas from bundling projects, cross compression, and less O&M activity, which were offset by increased O&M at GRGS and WGGS.

Component Emissions decreased by 8,348 Mscf (9%) to 87,399 Mscf from the 95,748 Mscf reported in 2017. PG&E experienced a YOY decrease of 5,556 Mscf citing the COGR for collecting more detailed data from individual facilities on all venting components as part of the inventory. Similar decreases at LGS and SoCalGas contributed to the remaining 2,973 Mscf decrease in 2018. For example, PG&E applied the quarterly pressure relief valve measurements as required by the COGR that reflect actual emissions instead of emission based on annual population based EFs.

Compressor and Component Leaks also experienced a decrease of 7,046 Mscf (15%) to 38,740 Mscf. PG&E emissions decreased YOY by 11,721 Mscf and sited the COGR for an increase in identified leaks, but their timely repair decreased the average number of days leaking resulting in the decreased emissions. This decrease represents the cancelling effect of increased surveys showing more leaks, which taken by itself

should increase emissions, but where decreased emissions occurred due to the faster repair that shortened the leak's duration. The effect of reducing the average days to repair results in a net decrease in emissions.

PG&E is the sole source of dehydrator emissions, which increased by 1.4 Mscf to 14 Mscf due to changes at a couple of PG&E's glycol facilities. All other dehydrator facilities use either a vapor recovery unit to reinject gas and/or thermally oxidize the glycol/methane mixture after dehydration with no reported emissions.

Unusual Large Leaks:

There were no unusual large leaks reported in 2018. The 2019 Winter Workshop included a review of the definition for categorizing this type of emission and it was determined that each discrete event depends on situational factors that should be reviewed and evaluated for inclusion in Unusual Large Leaks. The determination should not be based solely on an emission threshold level, nor should it be left to the utility's discretion. Staff will continue to analyze the annual filings for leaks that might warrant inclusion in this category and work with respondents to help identify discrete events that may qualify as an Unusual Large leak.

Lessons Learned

In 2018 the data collection and review process did not change significantly from 2017 with the usual interaction between Staff and respondents to refine the annual data and understand YOY fluctuations. Staff found that the COGR provided challenges for some of the smaller respondents and increased the complexity of drivers of YOY fluctuations. In addition, emissions estimation methods are evolving to keep pace with implementation of gas company Compliance Plans in order to reasonably estimate emissions reductions being realized. As in prior years there continue to be lessons learned from this year's submittal and review process. The most significant Lessons Learned to be shared are:

- Because of different mitigation projects and approaches taken by each reporting entity as they try to minimize emissions, there will be discrete emissions accounting methods employed by individual respondents that may not be universally applicable to all respondents. For example, the super emitter

program as implemented by PG&E posed challenges in reporting and pointed to potentially useful granular understanding of emissions drivers that would not apply to other entities implementing their survey program differently. The same could be said for SEMPRAs method of implementing its Vintage pipe program and that used a utility specific approach to reporting their emissions, which may not be applicable to other entities.

- Staff continue to see different interpretations of reporting requirements. A greater effort needs to be made in future reporting workshops to ensure a common or standard understanding that is shared by all respondents to minimize differences in reporting. This observation stems from the differences in how entities chose to report the COGR component leaks in their templates. Some summarized the leaks of each asset type and others listed each discrete leak, and in one case an ISP did not include the leaks they found in their filing. This points to Staff doing a better job communicating what is required and how to do it during the annual template workshop.
- Staff continue to find inadvertent and unforeseen improvements in reporting once the data comes in, which poses challenges in evaluating and modifying the reporting templates during the summer review cycle. As an example; the establishment and calculation of Sempra's average leak rates used for estimating Unknown Leaks was modified and improved during the summer review cycle.
- The importance of developing and communicating the process for prior year adjustments. This will be organized and discussed during the 2020 Winter Reporting Workshop. It appears that significant time should be devoted to this complicated area given the financial ramification associated with meeting emissions reduction goals in 2025. Therefore, Staff will seek respondent feedback on whether one day or two are needed for the 2020 Winter Workshop.

Conclusion:

The major findings from the 2018 data are:

1. The PG&E Super Emitter surveys had a positive impact decreasing PG&E Distribution Mains & Services (DM&S) pipeline emissions significantly by recognizing the impact of repairing and removing Super Emitting leaks from their distribution system.

2. The SoCalGas/SDG&E reduced emission in 2018 by implementing annual surveys focused on vintage pipe materials, which in the short term identifies more vintage leaks in the current period and removes them from the estimated unknown leaks (reported in Graded Pipeline Leaks). Over time the overall number of leaks in the vintage pipelines should decrease as they are detected and repaired on an annual basis. SoCalGas/SDG&E adopted a similar program for vintage steel pipe in 2019. PG&E adopted a similar program for vintage steel and vintage Aldyl-A pipes in 2018.
3. The implementation of maintenance best practices, which include vacating gas from lines, bundling work, and better scheduling techniques, continue to contribute to the significant reduction in blowdown emissions. Blowdown emissions fluctuate based on activity drivers (e.g. number of repairs, pipe replacement, dig-ins, general O&M, etc.) and emissions are expected to fluctuate depending on YOY activity levels.
4. The COGR resulted in more granular leak detection, shorter average time to repair that decreases emissions, focus on Compressor and Storage facilities' emissions, and switching from the use of annual facility or component EFs based on component population to emissions based on number of leaks using leaker EFs. The result was a net decrease in emissions from Component and Compressor leaks and facility leaks due to shorter time to repair and leak duration.
5. The more frequent COGR surveys helped identify increased emissions from rod packing indicating that when coupled with a proactive compressor emissions monitoring system for early detection of rod packing degradation and timely maintenance, these types of emissions could be decreased.
6. To the extent possible the cost of the additional COGR surveys and leak and emissions mitigation activities resulting directly from the additional surveys, should be considered for cost benefit analysis in future compliance plans. This would contribute to understanding of the holistic costs and benefits from all leak abatement activities.
7. Any adjustments to the 2015 Baseline that are needed to reflect more accurate reporting methods should be completed as soon as possible. An accurate 2015

baseline is important for all entities to have a firm idea what and where to reduce emissions. Also, now that D.19-08-020 will restrict cost recovery of PG&E's and SoCalGas's LUAF in 2025 should they fail to reduce emissions by 20% of 2015 Baseline. Staff will review the known issues with previously reported emissions balances and discuss the best approaches for adjusting prior period balances during the 2020 Winter Workshop, with the goal of making appropriate adjustments in time for inclusion in the 2020 annual report.

8. COGR changed emissions identification and accounting methodology, impacting 2018 emissions and has further implications on whether the respondents were fairly accounting for compressor and component emissions in prior years, including 2015. The information gained, from the enhanced survey protocols implemented in 2018, concerning compressors and storage facility emission profiles indicates that similar, emissions may have occurred during prior years. To fairly measure the success or failure of the emissions reduction program, the emissions baseline should be as accurate as possible. Therefore, an evaluation to determine whether baseline adjustments are appropriate appears warranted.

Appendix A: Methods for Estimating Emissions

Explanation of methods used for reporting and estimating leaks and emissions in the Joint Report.		
System Categories	Emission Source Categories	Description
Transmission Pipeline	Pipeline Leaks	Pipeline operators were instructed to provide emissions using the approved EF by number of miles of pipeline. It was determined that use of the EF from INGAA Greenhouse Gas Emission Estimation Guidelines for Natural Gas Transmission and Storage - Volume 1 GHG Emission Estimation Methodologies and Procedures (September 28, 2005 - Revision 2) - Table 44 study would be the best available for Transmission Pipeline emissions at this time.
	All damages (as defined by PHMSA)	Event specific emissions data reported where emissions were estimated either from modelling or size of breach using pressure and duration to calculate the emissions.
	Pipeline Blowdowns	The blowdown emissions are calculated based on unique equipment attributes and measured with engineering calculations on an individual basis.
	Component Emissions:	The emissions from components associated with transmission pipeline operations are based on the recommended EFs outlined in Appendix 9 of the Data Request. In some cases, the components did not meet the definition for the EFs and discrete approximations based on manufacturer provided leak rates, direct measurement of the different operating states as well as the for specific values recommended for use in calculating component specific leaks times number of units of equipment.
	Pneumatic Devices	
	Pressure Relief Valves	
	Component Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive component leaks in this category. This differentiates them from emissions from components that result from normal operations or by design. No emissions were reported in this category for RY 2016.
Odorizer (Odorizer and Gas Sampling Vents)	The EFs recommended in Appendix 9 were used where directly applicable, however where transmission pipeline dehydrator equipment did not match the pipeline operators used the discrete equipment attributes and operations profile to estimate emissions. The methods used appeared to provide the best estimate of emissions given the variety and operating context of these facilities.	
Transmission M&R	M&R Stations	The emission estimate for M&R stations are based on the EFs recommended in Appendix 9 multiplied by the population of each type of M&R station.

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	M&R Components Emissions.	The purpose of this category is to capture emissions that occur in M&R station components that result from normal operations or by design of the component. The emissions from components are captured in the EF used on a station by station basis and the discrete information on a subset of components in the facility would duplicate emissions and present misleading count information. Until further work can be done with more comprehensive survey techniques relying on the recommended EFs on a station by station basis is considered the best estimate of emissions at this time.
	M&R Leaks	This new category was added to the reporting templates for RY 2016. The purpose of this category is to capture fugitive leaks on components within the M&R station and create a record as a basis for evaluating using actual measured leaks rather than an M&R station EF for estimating emissions. Currently the discrete leaks for M&R stations would be captured in the recommended EFs used to estimate the M&R station emissions and only where it could be determined that inclusion of discrete M&R leaks were not duplicated would they be included in the count of emissions for this category.
	M&R blowdown	Blowdown emissions were estimated based on the calculation of the unique equipment volume being vented corrected for pressure and temperature at the time of the release. The estimates for blowdown events in general provide a reliable emission estimate.
Transmission Compressor Stations	Compressor Equipment - Centrifugal and Reciprocating.	The emissions calculated based on the direct measurement of each compressor unit given its operating state and pressure, and then the emissions are based on number of operating hours in each operating state.
	Compressor Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive leaks in this category and differentiate them from emissions from compressors that result from normal operations or by design. There were no discrete compressor leaks in RY 2016.
	Equipment and pipeline blowdowns	Blowdown emissions were estimated based on the calculation of the unique equipment volume being vented corrected for pressure and temperature at the time of the release. The estimates for blowdown events in general provide a reliable emission estimate.
	Components Emissions.	The equipment and component emissions are based on the leaks detected at the compressor stations times the recommended EF for that type of equipment per Appendix 9. The purpose of this tab is to capture emissions that result from normal operations or by design.
	Component Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive component leaks in this category. This differentiates them from emissions from components that result from normal operations or by design. No emissions were reported in this category for RY 2016.

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	Compressor Station Storage Tanks	These emissions are based on discrete tank pressure fluctuations due to exterior temperature fluctuations. The initial volume of gas release calculation is based on the starting and ending pressures assuming a constant temperature.
Distribution Mains and Services Pipelines	Pipeline Leaks - Below Ground	The emissions from leaks detected in 2016 in Distribution Mains and Service pipelines are calculated assuming that the leak was emitting from the first day of the calendar year through date of repair, or the entire year if not repaired in 2016, times the recommended EF. For identified leaks carried over from prior years the emissions are calculated from the beginning of the year through repair date (if repaired in 2016) or end of year times the recommended EF. In addition, leaks occurring in un-surveyed parts of operator's service territory were estimated based on the leak occurrence rate in the surveyed portion of the territory extrapolated based on number of years in the survey cycle to come up with the number of expected leaks in the un-surveyed territory times the recommended EF. This method of estimating the emissions from leaks occurring in un-surveyed portions of the service territory is considered a reasonable way of approximating the emissions and considers the frequency of leak detection surveys.
	Pipeline Leaks - Above Ground	See above for below ground leaks. Above ground leaks associated with MSAs are not counted in the volume or the numbers of leaks in order to prevent misleading representation of emissions as well as potential for duplication of emissions volumes.
	Blowdowns and Venting	Blowdown emissions were estimated based on the calculation of the unique equipment volume corrected for pressure and temperature at the time of the release. The estimates for blowdown events in general provide a reliable emission estimate.
	All damages (as defined by PHMSA)	<p>Emissions from damages for Above Ground (AG) Non-hazardous and MSA damages are calculated based on company EF for above ground facilities times the number of days leaking unless an engineering estimate could be performed to measure the emissions. For AG Hazardous and Below Ground Code 1 damages, emission was estimated based on engineering calculation using pipe size, damage opening size, and duration. For Code 2 and Code 3 damages, the EF for Distribution pipeline leaks was used.</p> <p>In 2015 and 2016 all damages for DM&S above and below ground as well as MSA above ground damages are aggregated in this category.</p> <p>Where an estimate was not made at the time of the event, the emission was estimated from population of similar events with respective pipe material and pipe size.</p>

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	Components - Pneumatic Devices	Emissions from components such as pneumatic devices are based on manufacturer specifications for bleed rate given the pressure.
	Component Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive component leaks in this category. This differentiates them from emissions from components that result from normal operations or by design. No emissions were reported in this category for RY 2016.
	Odorizer (Odorizer and Gas Sampling Vents)	Not applicable for this category.
Distribution M&R Stations	M&R Stations	The emission estimate for M&R stations are based on the EFs recommended in Appendix 9 multiplied by the population of each type of M&R station.
	Blowdowns	Blowdown emissions were estimated based on the calculation of the unique equipment volume corrected for pressure and temperature at the time of the release. The estimates for blowdown events in general provide a reliable emission estimate.
	Component Emissions	The purpose of this category is to capture emissions that occur in M&R station components that result from normal operations or by design of the component. The emissions from components are captured in the EF used on a station by station basis, and any discrete leak information from components in the facility would duplicate emissions and present misleading count information. Until further work can be done with more comprehensive survey techniques, continued reliance on the recommended EFs on a station by station basis is considered the best estimate of emissions at this time.
	Component Leaks:	This new category was added to the reporting templates for RY 2016. The purpose of this category is to capture fugitive leaks on components within the M&R station and create a record as a basis for evaluating using actual measured leaks rather than an M&R station EF for estimating emissions. Currently the discrete leaks for M&R stations would be captured in the recommended EFs used to estimate the M&R station emissions and only where it could be determined that inclusion of discrete M&R leaks were not duplicated would they be included in the count of emissions for this category.
Commercial, Industrial and Residential Meters	Residential and Commercial Meters	The emissions for this category are based on the MSA population count times the recommended EF per Appendix 9. There is substantial work currently being done to update EFs for MSAs and in future any updated EFs could be backward applied to 2015.

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	Actual MSA Leaks	This new category was added to the reporting templates for RY 2016. The purpose of this category is to capture fugitive leaks on MSAs and create a record in order to form a basis for evaluating using actual measured leaks rather the number of meters in the population times an EF to estimate emissions. Currently the discrete MSA leaks would be captured in the current method using EFs time the population of meters.
	All damages (as defined by PHMSA)	Emissions from damages for Above Ground (AG) Non-hazardous MSA damages should be calculated based on company EF for above ground facilities times the number of days leaking. For AG Hazardous damages, emission should be estimated based on based on engineering calculation using pipe size, damage opening size, and duration. The reported damages in this category were re-categorized and included with DM&S pipeline damages because not all respondents were capable of separating out their AG - MSA related damages with their AG - DM&S damages. Grouping them all together in this year's report is consistent with the grouping used in 2015. However, in the future separating the respective AG damages will help differentiate the source of damages and emissions.
	Component Emissions:	This new category was added to the reporting templates for RY 2016. The purpose of this category is to capture fugitive leaks on components other than MSAs in the MSA systems to determine whether such leaks existed. In addition, if such leaks existed this could form a basis for evaluating using actual measured leaks rather than an EF for estimating emissions. No component leaks were identified or reported in 2016.
	Vented Emission from MSA	Emissions from venting MSAs are based on the number of events times the estimated volume release by MSA and/or the type of activity.
Underground Storage	Facility Leaks	Emissions in this category are based on EPA GHG Subpart W data EFs multiplied by the number of units of each equipment type. Or respondents may use EFs from MRR Leaker Emission Factor Table W4, or they may choose to use Leaker based EFs, which means that if a survey is conducted, those components found not to be leaking would be recorded with zero emissions as opposed to applying a population-based EF. Just as those components found to be leaking would use a "Leaker EF" with a proscribed value.
	Compressor Emissions	Emissions from storage facility compressors are calculated in the same manner as for compressors in other categories. See the description in the Compressor Station category.
	Compressor Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive leaks in this category and differentiate them from emissions from compressors that result from normal operations or by design. The emissions from components associated with compressor operations are based on the recommended EFs outlined in Appendix 9 of the Data Request.

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	Blowdown and Venting	Blowdown emissions were estimated based on the calculation of the unique equipment volume corrected for pressure and temperature at the time of the release. The estimates for blowdown events in general provide a reliable emission estimate.
	Components Emissions:	Component emissions are based on the emissions that occur as a result of normal operation of the component or its design. The emissions detected during GHG leak survey pursuant to the GHG Mandatory Reporting Regulation and each component's EF times the population count. All leak and component emission estimates assume that the leak is leaking the entire year or during its identified hours of operation.
	Component Leaks:	This new category was added to the reporting templates for RY 2016. The purpose is to capture fugitive leaks in this category and differentiate them from emissions from components that result from normal operations or by design. The emissions from components associated with transmission pipeline operations are based on the recommended EFs outlined in Appendix 9 of the Data Request.
	Dehydrator Emissions	Because there are several different types and configurations of dehydrators and it was determined that the majority of respondent's dehydrators use a control device to eliminate natural gas emissions. Therefore, only those dehydrators which vent natural gas are included in this category. The dehydrator emission estimate is based on the engineering estimate, manufacturer's data, or MRR prescribed method of calculating natural gas emissions.

Appendix B: Definitions

For the purposes of SB 1371, the definitions of “leak” and “gas -loss” and the formula for calculating a “system-wide gas leak rate” were defined in a different manner than elsewhere. A “leak” was defined as any breach, whether intentional or unintentional, whether hazardous or non-hazardous, of the pressure boundary of the gas system that allows natural gas to leak into the atmosphere. Any vented or fugitive emission to the atmosphere is considered a “leak”. Examples of leaking components include defective gaskets, seals, valve packing, relief valves, pumps, compressors, etc. Gas blowdowns during operations, maintenance and testing (including hydro-testing) were also included as leaks. Consequently, this leak definition is broader than the Pipeline Hazardous Material and Safety Administration’s (PHMSA) definition.

The gas respondents are required by Federal Law, 49 CFR 192, to survey their systems for leaks, which could be hazardous to public safety or property. To accomplish this, the gas utility companies developed graded leak programs to detect, prioritize and repair the safety related types of leaks. The same definitions are used within this report and are as follows:

- Graded Leaks – hazardous leaks or, which could potentially become hazardous as described below:
 - A "grade 1 leak" is a leak that represents an existing or probable hazard to persons or property and requiring prompt action, immediate repair, or continuous action until the conditions are no longer hazardous.⁴⁸
 - A "grade 2 leak" is recognized as being non-hazardous at the time of detection but justifies scheduled repair based on the potential for creating a future hazard.⁴⁹
 - A "grade 3 leak" is a leak that is not hazardous at the time of detection and can reasonably be expected to remain not hazardous.⁵⁰
- Vented Emissions are releases of gas to the atmosphere, which occur during operations or maintenance, for a safety reason. Some examples are:
 - Purging (a.k.a. “blowdown”) gas prior to hydro-testing a line.
 - Gas releases designed into the equipment function, such as gas emitting from relief valve vents or pneumatic equipment.
 - Gas releases caused by operations, maintenance, testing, training, etc.
 - Ungraded Leaks are the remaining leaks, which are not hazardous to persons and/or property.

⁴⁸ Refer to GO 112-F for more information.

⁴² Ibid.

⁵⁰ Ibid.

For further information please see CPUC GO 112-F.

Lastly, in 2014 the system-wide gas leak rate was calculated as a percent of total input for the 12 months ending June 30 of the reporting year. However, Staff determined that there were problems with this calculation and opted not to report a leak rate using this formula. The formula for calculating a system-wide gas leak was written as follows:

Pipeline Hazardous Material and Safety Administration (PHMSA)
Modified Equation for Lost and Unaccounted for (LAUF) Gas:
[(Purchased gas + produced gas + transported gas entering the gas system) minus (customer use + company use + appropriate adjustments + gas injected into storage + transported gas leaving the gas system)] divided by (Purchased gas + produced gas + transported gas entering the gas system) = System Wide Gas Leak Rate.

Note: transported gas includes gas purchased by customers and transported in common carrier pipelines.

In section 5 of the 2015 Joint Report, "Baseline System-Wide Emissions Rate," Staff determined the value for 2015 to be 0.32% by using the total emissions from all source categories (6,601.2 MMscf) divided by the Total Annual Volume of Gas Transported (2,056,950 MMscf). The five sources for Total Annual Volume of Gas Transported include:

- Gas Injected into Storage
- Storage – Gas Used by the Gas Department
- Gas Transported to Customers in the State
- Gas Transported to Customers out of State
- Distribution – Gas Used by the Gas Department

Appendix C: Article 3, Section 975 (c) and (e)(6)

Article 3. Section 975

(c) As soon as practicable, the commission shall require gas corporations to file a report that includes, but is not limited to, all the following:

- (1) A summary of utility leak management practices.
- (2) A list of new natural gas leaks in 2013 by grade.
- (3) A list of open leaks that are being monitored or are scheduled to be repaired.
- (4) A best estimate of gas loss due to leaks.

(e) The rules and procedures adopted pursuant to subdivision (d) shall accomplish all the following:

- (6) to the extent feasible, require the owner of each commission-regulated gas pipeline facility that is an intrastate transmission or distribution line to calculate and report to the commission and the State Air Resources Board a baseline system-wide leak rate, to periodically update that system-wide leak rate calculation, and to annually report measures that will be taken in the following year to reduce the system-wide leak rate to achieve the goals of the bill.

Appendix D: Conversion of Natural Gas to Carbon Dioxide Equivalents

The conversion of natural gas volume to carbon dioxide equivalent mass requires the use of a GWP value. CARB used the GWP value of 25 (100-year value) from the IPCC, AR4, for previous GHG emissions inventory. The following calculations show the conversion of the total emissions from this report. The conversion was done in two steps. In the first step, the calculation shows the volumetric natural gas that contains exactly one metric ton of methane.

$$1 \text{ MT CH}_4 * \frac{2,204.62 \text{ lbs CH}_4}{1 \text{ MT CH}_4} * \frac{1 \text{ lb mole}}{16.04246 \text{ lb CH}_4} * \frac{379.48 \text{ scf of CH}_4 \text{ gas}}{1 \text{ lb mole}} * \frac{1.0 \text{ scf of natural gas}}{0.934 \text{ scf of CH}_4 \text{ gas}} * \frac{1 \text{ Mscf}}{1,000 \text{ scf}} = 55.835 \text{ Mscf of natural gas}$$

Using this volumetric unit, the 2018 total emissions, 5,971 MMscf, is equivalent to about 2.67 MMTCO₂e, as shown below:

$$5,970,520 \text{ Mscf natural gas} * \frac{1 \text{ MT CH}_4}{55.835 \text{ Mscf of natural gas}} * \frac{25 \text{ CO}_2e}{1 \text{ CH}_4} = 2,673,287 \text{ MT CO}_2e$$

CARB has also used the GWP value of 72 (AR4, 20-year) in the Short-Lived Climate Pollutant Plan and Oil and Gas Regulation. Based on the higher GWP, the 2018 total emissions, 5,971 MMscf is about 7.70 MMTCO₂e, as follows:

$$5,970,520 \text{ Mscf natural gas} * \frac{1 \text{ MT CH}_4}{55.835 \text{ Mscf of natural gas}} * \frac{72 \text{ CO}_2e}{1 \text{ CH}_4} = 7,699,067 \text{ MT CO}_2e$$

The use of 1.0 scf of natural gas per 0.934 scf of CH₄ gas accounts for composition of natural gas being not 100% methane. The American Gas Association published a value of 93.4% to be used as a default methane concentration that is comparable to what respondents reported.⁵¹ The standard cubic foot “scf” for measuring gas is based on 60 degrees Fahrenheit at atmosphere pressure.

In addition, respondents reported trace amounts of concentration for ethane, inert gases, and other elements and compounds. There was not an entry for carbon dioxide explicitly, and so it cannot be assumed that all the inert gas was carbon dioxide. A calculation was performed that showed CO₂ emissions from the inert gases would be less than 0.1% of the total and is excluded in this report.

⁵¹ AGA, GHG Guidelines, page 39, April 18, 2008, http://s3.amazonaws.com/zanran_storage/www.aga.org/ContentPages/18068841.pdf